Vol. III

TRANSCRIPT OF RECORD

(Pages 989 to 1500)

Supreme Court of the United States

OCTOBER TERM, 1944

No. 50

THE DOW CHEMICAL COMPANY, PETITIONER,

vs.

HALLIBURTON OIL WELL CEMENTING COMPANY

No. 51

HALLIBURTON OIL WELL CEMENTING COMPANY, PETITIONER,

vs.

THE DOW CHEMICAL COMPANY

ON WRITS OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SIXTH CIRCUIT

PETITIONS FOR CERTIORARI FILED { APRIL 6, 1944. / APRIL 17, 1944.

CERTIORARI GRANTED MAY 15, 1944.

Supreme Court of the United States

OCTOBER TERM, 1943

No......................

THE DOW CHEMICAL COMPANY, a Corporation,
Petitioner,

vs.

HALLIBURTON OIL WELL CEMENTING COMPANY,
a Corporation,
Respondent.

Transcript of Record

On Petition for Writ of Certiorari to the United States Circuit Court of Appeals for the Sixth Circuit

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Volume III—Pages 989 to 1500

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IN THE

UNITED STATES CIRCUIT COURT OF APPEALS

FOR THE SIXTH CIRCUIT

No. . . . .

THE DOW CHEMICAL COMPANY, A CORPORATION,
Plaintiff-Appellant,

vs.

HALLIBURTON OIL WELL CEMENTING COMPANY,
A CORPORATION,
Defendant-Appellee.

Appeal from the United States District Court for the Eastern District of Michigan, Northern Division

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FRANK PALIN SPRUANCE,

testified as follows by deposition:

DIRECT EXAMINATION

My residence is 8204 Cedar Road, Elkins Park, and my occupation is vice-president of the American Chemical Paint Company, at Ambler, Pennsylvania. I have been connected with the American Chemical Paint Company since 1920 or '21, in connection principally with sales. I was graduated a mechanical engineer from the University of Pennsylvania but have had very little to do with the technical work of the company. Mr. Douty, and formerly Mr. Gravell, now deceased, have had charge of that work since my connection with the company. Mr. Gravell was president of the company. The company maintains a technical laboratory. It has maintained it since about 1923, when Mr. Douty came with it. Previous to that time Mr. Gravell did all of the development work and all of the chemical work for the company. Mr. Douty organized this laboratory work, under Mr. Gravell's supervision, and has worked very closely with Mr. Gravell in the technical developments. Mr. Gravell has been dead since December of 1939. During the first few years the company had the technical laboratory there were only two on the technical staff, Mr. Gravell and Mr. Douty, and they worked side by side and hand in hand, collaborated very closely. That would apply up to the year that Mr. Gravell died. Mr. Douty's official title was chief chemist, and has been at all times. My duties at times have had to do with the sales end.

The principal business of the American Chemical Paint Company when I first became connected with it was the manufacture and sale of acid cleaners, for preparing metals for painting, and in addition, soldering fluxes used on metal, and in addition to that we had a product known as

Lithoform, which was used to coat galvanized iron so that the paint would adhere to it. The Deoxidine was the only one of those products that contained acid. It contained phosphoric acid. It was originally shipped in wooden barrels with a rubber lining. We used the rubber lining because it was the only container we found that we could suitably carry the Deoxidine in, and even so, we had a great deal of trouble with the Deoxidine leaking out through pinholes in the rubber and getting onto the hoops and corroding the hoops, and the barrel went to pieces. Without the rubber lining that would have happened very, very quickly. That method—I don't remember exactly the date, but I think that that continued until about 1926. We continued to manufacture and sell Deoxidine after that date and shipped it in steel drums, and still do.

As to other acid products our company now manufactures inhibitors, the trade name of which is Rodine. We have another inhibitor of the Rodine type, which we designate as Murodine. Sulphuric and muriatic acid are used in those products, but both acids are not used in the same product. We would have muriatic acid in the case of one particular Rodine, and we would have sulphuric acid in the case of other Rodines, but I know of none in which both acids are used. We have sold Rodine—I have forgotten the date, Mr. Douty can give you the dates more accurately that I can, but I would say from about 1923 on. Murodine we first made and sold about 1926 or '27. I think muriatic acid was used in Murodine. That is still manufactured and sold. In some Rodines we use sulphuric acid as an ingredient and in other Rodines we use muriatic acid or hydrochloric acid as an ingredient, and in Murodine we use only the hydrochloric. But let me make this explanation, that I wouldn't want to be held too definitely to the formulation of these materials. Now, there may be some small amount of one or the other acid in one of these materials which may come in in the process of manufacture, but the Murodine, as I remember it, is predominantly muriatic acid.

We manufacture phosphoric acid ourselves, at New-castle, Delaware, and ship it in rubber lined barrels. We ship our Rodine in steel drums and we ship our Murodine I think, in wood barrels—for a reason. We have always shipped our Rodine in steel drums.

We first began to manufacture and sell Rodine about '23 or '24—now, Mr. Douty has the dates on that more accurately. That is my recollection, '23 or '24. Rodine was used to prevent acid dissolving metal. It was used in the steel industry in a process which is known as pickling, where steel is introduced into diluted acids for the purpose of removing scale, scale being the black oxides of iron. It is also used to remove rust, in some cases. There are some plants where muriatic acid is used. Sulphuric acid is preferable, principally on account of the cost, in the pickling process in the steel mills. Rodine is placed in either one of those acids, according to whichever one is used. Sulphuric acid is used in the pickling industry in strengths which will vary from two per cent to ten per cent by volume and the rest of the volume is water except for the small quantity of Rodine that is also added. The Rodine concentration will vary from one-eighth per cent to one per cent, and that percentage is based on the volume of the undiluted acid, and those percentages which I have just stipulated are such as are used in the pickling in steel mills for the removal of scale, and in miscellaneous industries for the removal of scale or rust. The undiluted sulphuric acid which I have referred to above is either 60 or 66 degree Baume, and the sulphuric acid solution used in pickling in the steel mills is made up of from two to ten per cent of sulphuric acid of from sixty degrees to sixty-six degrees Baume. To that solution there is added from one-eighth of a per cent to one per cent of Rodine.

Hydrochloric acid is used much stronger than sulphuric acid in the pickling industry. The strength of the solutions will vary, and commercially they might be used from twenty per cent to one hundred per cent by volume of the commercial muriatic acid which is either 18 degrees Baume or

20 degrees Baume. Sometimes that 18 degree or 20 degree Baume hydrochloric acid is used undiluted. It is used in diluted solutions perhaps in the same plant. The strength of the acid is the factor which controls the speed of removing scale or removing rust, or removing lime deposits, or removing whatever is to be removed. The stronger the acid, the more rapid the action, in most cases. The concentrations of Rodine or Murodine in muriatic acid pickling solutions will vary widely, but they will range from one-eighth to three per cent by volume of the undiluted commercial muriatic acid.

Our company has carried on a pickling business of its own and we conduct such business now. My testimony regarding the acids used in pickling, and the strengths of acids used, and the proportions of Rodine or Murodine used, is based on operations which we have controlled or advised in the steel mills, in tremendously big proportions, in large quantities, in many mills. My testimony applies to the pickling operations as commonly carried on by the big mills, and we use Rodine and the acid solutions in the same general way in our own pickling, wherever we do it here, and we have generally used it whenever we did, and that, as I said before, has gone back to time immemorial in the history of this company, because we have always had occasion to do some pickling in experimenting with other processes of treating metals.

There are many objects in pickling iron or steel. First, because of the very large tonnage and very general application, I would place the object of pickling as the removal of mill scale, as it is called. Mill scale is the oxide coating which forms on steel when it is heated. This scale must be removed before the steel can be subsequently fabricated. Another purpose for pickling is to remove rust. The effect is much the same, and the use of the solution is much the same as that in pickling for the purpose of removing scale. Another use is for the removal of calcareous deposits from equipment, such as bottle and can washing machines, automobile radiators, wells. The only thing that I would class

as actually the pickling art is the removal of mill scale and the removal of rust. The sheet metal as it comes from the steel mills does not usually have a calcareous deposit on it, and pickling as I have defined it is not usually intended to remove calcareous deposits, but there are times when steel comes from the mill with a coating of lime on it, and with that lime is rust, and in that case the steel is pickled, and the lime and the rust are both removed. If there is any calcareous material on the steel the pickling operation would remove it. I don't know how lime would get on the steel before it comes to the pickling vat, but I know how it would get on the steel after it has gone through the pickling vat, and that is where it is put on, they use the lime to neutralize the spent acid, and a coating of lime and calcium carbonate and probably calcium sulphate is left on the steel. They re-pickle it to remove that material in the fabricating plants. Steel is pickled many times. All steel is pickled many times. Lime is not used in the pickling solution; it is used in a separate wash tank, as a neutralizer to wash the acid off the steel after it is pickled. What they use after the pickling operation which results in putting a lime coating on the pickled material is powdered lime. Just dry powder.

Q. You say you don't know in what form the lime is used for this purpose, except that it is in powder form? A. That is right.

Q. And that is all you know about it? A. That is all I know about it.

My principal reason for knowing that these pickled sheets, after they are treated with the powdered lime, contain a calcareous deposit, is the method of deduction. You have heard that you can't make purses out of sows' ears, and you can't get anything except lime coatings out of a solution that contains lime. In pickling sheets of iron or steel it is desirable to leave the surfaces clean and free from any other materials.

In the pickling operation the Rodine is used to prevent the acid unnecessarily dissolving the metal. In other words,

it is used to protect the metal against acid attack. This statement is made having in mind the addition of the Rodine to the pickling solution in the mills. As to Murodine, this material has not been offered for the pickling industry. That material was developed solely and entirely for use with muriatic acid, as this was used in the oil industry for cleaning oil wells. The purpose of Rodine is to prevent acid attacking metal.

We sell Murodine for the purpose of preventing the attack of acids on metals. That is not sold in the pickling industry, but its purpose is the same purpose. It is not used in the pickling industry under that name. Murodine is of the same nature as our Rodines, but Murodine was so named because it was used specifically in muriatic acid. The bulk of the pickling that we are serving is sulphuric acid and Murodine as compounded is not suitable for use with sulphuric acid. We sell our Rodine and our Murodine to different classes of customers. We do not sell them to the same customer. We sold Murodine to the oil industry, and to no other industry. We sell Rodine to the pickling industry and now to no other, but we did sell Rodine to the oil industry in the early days. By the early days I refer to 1926, '27, '28, somewhere along there.

Mr. Owen: Do you know of your own knowledge the uses for which your Rodine was used in the oil industry in 1926 or 1927 or thereabouts? A. It was used to remove calcareous deposits from oil wells, to increase the flow of oil into the well, and without doing unusual harm to the tubing and casing.

Q. You are testifying of your own knowledge, now? A. I have never seen it so used, but I have heard of its use many, many times.

Mr. Owen: I move to strike out the last two preceding answers as irresponsive and volunteered.

Mr. Owen: Now, I will ask you again, Mr. Spruance, and I warn you that I want your own knowledge and not what someone else told you, do you know of any instance where Rodine was used in the oil industry for any purpose

prior to 1932, and if it was so used, in exactly what way was it used? A. You put me in an embarrassing position, because, as I said before, I never saw it so introduced, but I am just as sure as to how it was used,—

Q. No, no,—

Mr. Richmond: No, just a minute. Go ahead, let the witness answer, and you can move to strike out.

Mr. Owen: I want the witness to confine himself to the question. This witness is not a witness on behalf of the plaintiff in the sense that he is a biased party for the plaintiff. He is really a party-defendant to this case, because it was his company which developed the Gravell patent and which sold it to your company to bring suit against us. Therefore, this witness is not permitted or should not be permitted to volunteer testimony, and he should not be permitted to testify to anything that he does not know of his own knowledge.

Mr. Richmond: Well, he has a right to testify as an official of the American Chemical Paint Company what he knows from its records and from his position as the head of sales of that company.

Mr. Owen: If the witness can—

Mr. Richmond: And I certainly object to your lecturing the witness. You ask him the questions, and if he doesn't give you the answers, why, you have a proper way to get them.

Mr. Owen: Now, I will ask you once more, Mr. Spruance, and in all good nature,— A. I am going to answer you in good nature, too.

(Continued): —If you know of your own knowledge of the actual use of Rodine in an oil well prior to 1932. A. I will again say that I have never seen Rodine put into an oil well for the purpose described, but I will say—

Mr. Owen: Now, I object—

Mr. Richmond: Go ahead. I object to your cutting the witness off.

Mr. Owen: I object to any further statement—

Mr. Richmond: This witness has a right to complete his answer.

Mr. Owen: —unless it is in response to the question.

Mr. Richmond: No, you can move to strike it out. Go ahead and continue your answer.

Mr. Owen: I don't want the witness to state what someone else told him.

Mr. Richmond: Now, complete your answer, Mr. Spruance.

The Witness: This is off the record.

(Discussion off the record.)

Mr. Richmond: Well, I ask that you finish your answer, and then let counsel move to strike it out if he wishes. Go ahead and say what you have to say.

Mr. Owen: Confine yourself to what you know, Mr. Spruance.

The Witness: I am perfectly sure that the—

Mr. Owen: I object to that.

The Witness: —that the Rodine—

Mr. Owen: I object to that, unless you know.

Mr. Richmond: Well, you have objected. Now, let the witness answer, and then move to strike it out as not responsive.

The Witness: —that the Rodine was used for the purpose of protecting the metal equipment in oil wells, because we were in the business of supplying materials for that very purpose, and the people who had the problem of protecting metal in oil wells came to us for relief.

Mr. Owen: I move to strike out that portion of the answer as irresponsive.

Mr. Owen: Now, I will ask you whether of your own knowledge you know of any instance where Murodine was placed in an oil well prior to 1932.

Mr. Richmond: Well, I will stipulate that was not ever used prior to 1932. Go ahead. A. It was not.

Mr. Owen: As your testimony now stands it is that you do not know when Murodine was first placed on the market. That is correct, is it? A. I don't recall the exact date, no.

Q. And that you don't know when Rodine was first

sold for use in the oil industry? A. I don't know the date of that.

CROSS EXAMINATION

I don't know exactly when the American Chemical Paint Company first sold a Rodine to be used as an inhibitor for hydrochloric acid that was to be used in an oil well, but I would say it was somewhere around 1925 or 1926 or 1927. We sold some to the Gulf and we sold some to the Gypsy oil companies.

Referring to a photostatic copy of an order from The Gypsy Oil Company, number 4069, dated September 19, 1928, I feel sure our company received the original of that order because I know we shipped Rodine to the Gypsy Oil Company. There was fifty-two gallons shipped, in a fifty-two-gallon steel drum.

Referring to a photostatic copy of Gypsy Oil Company order number 69422, dated September 23, 1929, with the received stamp of October 16, 1929, thereon for one ten-gallon drum of Rodine Number 2, I recognize that as an order that we received from the Gypsy Oil Company. I can't identify it exactly as to that date, but I know that we shipped Rodine at that time to the Gypsy Company.

Referring to order number 4069 of the Gypsy Oil Company, the Rodine that was called for is Rodine Number 2.

Referring to a photostatic copy of Gypsy Oil Company order number 117624, of August 14, 1930, I don't know whether it is '29 or '30, I recognize that as an order that we received from the Gypsy Oil Company for ten gallons of Number 2 Rodine. That was filled by our company.

Referring to what appears to be an invoice of the American Chemical Paint Company to the Gypsy Oil Company, at Pittsburgh, Pennsylvania, for ten gallons of Number 2 Rodine shipped in a ten-gallon drum, and dated the 12th, looks like '29, I can't make out the date, that is our company's invoice to the Gypsy Oil Company for the shipment to them of Rodine Number 2.

At the time of these four documents that have been called to my attention, my position with the American Chemical Paint Company was vice-president in charge of sales. The company had salesmen under my direction. We had salesmen in Pittsburgh, we had salesmen in Detroit, we had salesmen in Chicago, we had salesmen in the East. Our salesman at Pittsburgh was William S. Dietrich, who now resides in a suburb of Philadelphia. He was the salesman who would have made these sales to the Gypsy and to the Gulf that I have mentioned. He reported to me the purpose for which the Rodine was to be used. He told me that the Rodine had been found very effective as an addition to muriatic acid for the treatment of wells. He was working in collaboration with a Mr. Wescott, who was at that time associated with the Gulf Research. Mr. Wescott had tested the Rodine, and Mr. Dietrich informed me that Mr. Wescott had advised the various branches that Rodine was an effective material to prevent the action of acid on tubings and casings in acidizing wells, and that he had accordingly recommended its use.

Mr. Dietrich at the present time is pensioned. For two years he has been ailing very seriously with coronary thrombosis. He is confined to his bed most of the time and is not able to do any work at all, as a result of which we retired him on a very fair remuneration, and he is living as long as he will live without doing any work at all. His condition as to being able to appear in court I would say is hopeless. He can't even appear downstairs most of the time.

Since those first sales of Rodine Number 2 the American Chemical Paint Company has had Rodine Number 2 or its equivalent on sale for the purpose of removing calcareous deposits in oil wells. Our company has sold its Rodine or Murodine to the plaintiff, Dow, or its totally owned subsidiary, Dowell Incorporated. Such sales were made between 1928 and I would say 1938. I haven't got the exact dates of any sales to Dowell. I have got some figures here, but I can look that up. I think we sold Dowell

Murodine during the years 1936 and 1937. I do not know how much those sales amounted to, but I think I can find out.

Mr. Richmond: Now, can you give me, as briefly as possible, by years, if you would rather, the amount of sales of Rodines, Deoxidines and Murodines since you started making those articles, when they contained arsenic? A. I don't know when they first contained arsenic, but I am sure that is in the records in Douty's testimony; because I wouldn't be too accurate about the date.

1923, we sold approximately $250,595 worth of Deoxidine and $4,034 worth of Rodine. In 1924 we sold $209,661 worth of Deoxidine, and $14,757 worth of Rodine. In 1925 we sold $558,412 worth of Deoxidine, and $105,125 worth of Rodine. 1926, $735,950 worth of Deoxidine, and $133,440 worth of Rodine. In 1927, $901,559 worth of Deoxidine and $152,066 worth of Rodine. In 1928, $1,060,006 worth of Deoxidine, and $240,589 worth of Rodine. In 1929, $1,070,-130 worth of Deoxidine, and $332,678 worth of Rodine. In 1930 we sold $591,627 worth of Deoxidine and $242,762 worth of Rodine. In 1931 we sold $230,557 worth of Deoxidine, and $125,712 worth of Rodine. In 1932, $114,477 Deoxidine, and $104,269 Rodine. In 1933, $156,648 Deoxidine, and $202,027 worth of Rodine. In 1934, $200,738 worth of Deoxidine, and $212,036 worth of Rodine. In 1935, $198,956, Deoxidine, and $283,878 of Rodine. In 1936, $223,493, Deoxidine, and $343,055 worth of Rodine. In 1937, $226,368 Deoxidine, and $325,845, Rodine. In 1938, $142,619, Deoxidine, and $188,721, Rodine. In 1939, $161,-142, Deoxidine, and $260,656, Rodine. They are figures that are quite approximate—they are taken from a sales curve, they may be off in a few dollars or a few hundred dollars, but the volume is about right.

Mr. Owen: These figures which you have given include all sales of all Rodines of the various numbers which you manufactured? A. That is correct.

Q. Are you able to separate these figures and show what amounts of the different Rodines were sold during

each year? A. Not without a great deal of trouble. I should say this, that in the early days we had one Rodine or two Rodines, they were liquid—they were arsenic Rodines.

Q. And did you sell Deoxidines under different numbers and formulas? A. Yes, but it was about, I would say, about ninety-five per cent one kind; that is, there were a few special Deoxidines sold in very small quantities for certain specific customers, but the bulk of it was the standard grade.

Mr. Owen: I object to the figures with reference to Rodine unless they are separated into the different Rodine numbers. In bulk they don't mean anything, in my opinion.

Mr. Richmond: The Rodines, though, all contained—all the liquid Rodines contained arsenic? A. That is correct.

Mr. Owen: While we are on this question I think I should dispose of it. Do those figures that you have given for Rodines include any solid or powdered Rodines? A. In the later years, but not in the earlier years.

Q. In what years? A. Mr. Douty has given you the formula for 106 Rodine, which was our first powdered Rodine.

Q. And the sales of powdered Rodines are included in these figures you have given? A. In the later years, yes.

Mr. Owen: I object to the answer in so far as it relates to Rodines on the ground that it is indefinite, and does not set forth the Rodines which might be construed as coming under the Gravell patent in suit.

Mr. Richmond: Mr. Spruance, you have now, have you, before you the date of the first sale to Dow Chemical Company? A. I do. Of a Rodine, first sale is 4th month, 19th, 1935. I don't know what number it is now. It is Rodine. The first sale to Dowell Incorporated was 4th month, 19th, 1935. I have records of sales of Murodine to Dowell Incorporated here for the years 1935, 1936 and 1937. The sales to the Dowell Incorporated of Murodine for the year 1935 were $3,000. For 1936, $3600. For 1937, $232.50.

In the years 1935, '6 and '7, the total amount is $6,832.50. I haven't differentiated between Dow and Dowell. These figures cover both. I do not know why Dow Chemical Company and Dowell Incorporated quit purchasing Murodine from our company.

REDIRECT EXAMINATION

The figure of $6,832.50 which I gave for the total sales to Dowell and Dow covers all sales of our products to both of those companies during the years I mentioned. I cannot from the meager records I have before me, separate the Rodine sales from the Murodine sales or the different Rodines. I would say that they would include not over one Rodine and one Murodine. My personal recollection is that it was all Murodine 101. My recollection is that there was no Rodine. The $6,832.50 are sales of Murodine 101, if my recollection is correct.

I have no information regarding the use or uses to which the Gypsy Oil Company put the Rodine which it purchased from us, other than what appears on the orders themselves or what I said our salesman Dietrich told me. I have no personal information regarding the use to which that material was put.

The only sale of our materials to the Dow Chemical Company or Dowell Incorporated during those years other than Murodine would have been Rodine, and that is where my memory is not completely accurate as to whether it was Rodine and when it changed from Rodine to Murodine, but it was either Rodine Number 4, or Rodine Number 40, or it was Murodine Number 101.

RECROSS EXAMINATION

The information received concerning the Rodine sold to the Gypsy Oil Company was received by me in the regular order of business of the American Chemical Paint Company and in my official capacity as sales manager of that company from a salesman under my direction.

REDIRECT EXAMINATION

On the sales which we made to the Gulf Oil Company I have no information as to the uses to which the products were put other than what appears on the orders or what our salesmen told me other than that the salesmen reported to me that they were used for well cleaning, along with muriatic acid.

Mr. Owen: That was for cleaning "gyp" from the pipe? A. No, that was for increasing the flow of oil in the well.

Mr. Owen: Well, I object to the testimony as hearsay, and renew my motion to strike it from the record.

PAUL W. PITZER,

a witness for defendant, testified by deposition, as follows:

DIRECT EXAMINATION

I live in Breckenridge, Texas, and am in the oil and acidizing business. I am vice president of The Chemical Process Company, which company was incorporated in Texas in 1932 and is in the business of acidizing oil wells. I have been engaged in the business of acidizing oil wells continuously since 1932. The Chemical Process Company was organized for the purpose of acidizing wells. I am also

an oil man and have been for a number of years prior to the organization of The Chemical Process Company. Prior to the organization of that company I and my associates acidized some few oil wells, less than ten, I would say. Some of these wells were my own, the remainder belonged to others. These wells were located in Stephens County, Texas.

Mr. Babcock: Would you please describe briefly just what process or method you have employed in acidizing oil wells. First, state briefly just what you did prior to the organizing of the Chemical Process Company, and then go on and describe in general the process employed by The Chemical Process Company, and if there was any difference in what you did before and after it was organized? A. Why, there was not a bit of difference. On our first treatment we treated a well with 730 gallons of acid. This well belonged to Pitzer and West, that is, myself and partner, who were in the oil business together and worked at that business. Our records show this well was treated on October 13, 1932. We used muriatic acid in treating this well. We ordered it in carboys. I am not positive, but I think it came from the Texas Chemical Company at Houston, Texas. There was no inhibitor or other chemical used in treating this well. We used just straight acid. We mixed it with water and made a fifty-fifty solution. The acid was 18 Baume diluted down to a fifty-fifty solution, which would make a 15 Baume acid. The nature of our treatments after the organization of the Chemical Process Company was the same and is the same today. Our treatments consisted in just putting the acid into the oil well and displacing it either with water or oil to push it back into the formation. The acid was forced into the formation using whatever method was necessary, either from vacuum or from pressure.

Since the organization of The Chemical Process Company to date that company has made approximately fifteen thousand acid treatments to oil wells. This work has been done for practically the entire oil business. I mean by that,

that there are only a few oil companies for whom we have not acid-treated oil wells. We have treated oil wells for all the major oil companies, except The Pure Oil Company. I do not think we have ever treated a well for the Pure.

In these thousands of treatments we have made, we have used an inhibitor on a few wells. We did not use any inhibitor in 1932 or in 1933. We used the last inhibitor on a few wells during the period between the time of the decision in The Dow Chemical Company vs. Williams Brothers Well Treating Corporation suit, between the time it was tried and reversed. It was between the time of the trial of that case and the time the Appellate Court in Denver reversed it. We only used an inhibitor on a few wells between that time and the time it was reversed. It was not our common practice. After the reversal of that case we never used any more inhibitor and we have not used any since that time. We have not used any inhibitor since that case was decided on appeal.

Q. (Exhibiting instrument to witness): I hand you some kind of mimeographed document of 5 pages and will ask you what that is, if you know? A. Well, laying aside a chance for a few mistakes being made, that is supposed to be our business records of the wells we have treated, which we keep.

Q. Did you keep a record of only a part of the wells you treated? A. No, that's supposed to be a complete record through those dates on there, from the time we treated the first well for one year. That's a complete mimeographed copy of the wells we treated the first year.

(The document was offered and received as DX-298.)

The Witness: This document is an entire list of treatments made by the Chemical Process in the Breckenridge, Texas, district. The list is subject to error, but I understand it to be a list of wells which The Chemical Process Company treated on the dates listed. The list gives the amount of acid used on each well, which amount is correct to the best of my recollection. No inhibitor was used in any of these wells listed in DX-298, which list covers wells we

treated from October 13, 1932, to October 13, 1933, during the first year of the existence of The Chemical Process Company. All these wells were located in Texas, and most of them were in the Breckenridge district. There may have been one or two wells in the western part of the state that we treated. We have treated wells in Texas, New Mexico, Kansas, Oklahoma, Louisiana and Arkansas, and we may have treated a few wells in Kentucky. We have treated one or two wells in Nebraska, and I think we have been into Colorado on a treatment or two. This list of well treatments was prepared under my direction. We kept that record of the wells we treated and it is a true record of the wells we treated.

Out of the numerous wells we have treated with acid for the various oil companies, I think we have received one or two complaints due to the corrosion of the iron in wells. I do not regard the use of an inhibitor as necessary to the successful treatment of an oil well.

In the Breckenridge district of Texas there are a number of oil wells, and in general the oil is produced from a lime formation. This field is approximately twenty-one years old, or a little over. In 1932 when we started to acidize oil wells the production of oil from the wells in this field was not as great as it had been in previous years. The production was down to the pumping stage and there was not over one or two wells flowing in the county. A number of the wells were being plugged. Our treatment of these wells with acid was very successful. We helped practically all the wells we treated. As a result the oil operators changed their plans as to what they did with their wells, and immediately after we commenced acidizing it was common practice that the wells be acidized before they were plugged. The acid treatment materially increased the production in this field, and in this district in 1932, I would say, we had anywhere from a two-barrel increase to a hundred-barrel increase per day for each well. I think some of the increases ran even higher than that, but that is just a picture of it.

In the territory where we operate, and have operated, the purpose of the acid treatment is to increase the production of the well. It is our intention that the acid react with the calcium carbonate in the formation from which the oil is produced.

CROSS EXAMINATION

The exact date of incorporation of The Chemical Process Company is October 12, 1932. With respect to the date of the first well treated with acid by The Chemical Process Company, or treated with acid by me and my associate Mr. West, we have two wells we originally treated that are not in the records. One was a well in Eastland County, which we found out later had a sand formation. The next well we treated on October 13, 1932. We treated that well, the Akers No. 1, with 730 gallons of acid.

Mr. West, my associate, and I learned of the acidizing business in 1932 from a couple of fellows, named Markham and Melville, who came here and wanted to make an experiment with acid. I never heard of Dowell Incorporated or The Dow Chemical Company having acidized wells prior to the time we started acidizing wells.

The Chemical Process Company employs a chemist and maintains a complete laboratory. In some cases it is the practice of our company to retain samples of the acid used in treating the wells. Without inquiring, I am unable to say if we have any such samples on hand at present.

We received one or two complaints from operators for whom we had treated wells. These complaints were received on account of corrosive conditions. The acid attacked some parts of the well, or at least the operator so alleged. That is quite common with every operator in the business, or every acidizing company in the business. They run up against things of that kind.

REDIRECT EXAMINATION

Since 1932 our business has increased from year to year. We have had some years that were larger than others, according to how the oil business was going. Of course, in some years there is lots more drilling than in other years. I can say this, that our business has increased in the amount of work being done every year and has grown generally all during these years. We only used an inhibitor on a few wells. We only used it between the time that suit was tried. The business has grown at all times, but we did not use an inhibitor after that suit was reversed.

Mr. Conner: I object to the entire deposition as irrelevant and immaterial. Do you want us to show Chemical Process infringes the Grebe-Sanford patent in order to prevail that Halliburton infringes? That is exactly the position we find ourselves in this morning.

The Court: If you have a patent that is going to apply to the man that just goes and buys the ordinary commercial hydrochloric acid and uses it without putting anything at all in, why all right. You have to show me because I don't think that your patent covers that. I don't think your patent ought to cover a man who just buys ordinary hydrochloric acid and uses it. That is the old patent of 1896, or whatever date it was. That is what he says he does, you have it right there. If you claim he did something else, you ought to prove it.

Mr. Conner: That is just what it comes to. It comes to one thing, and that is this: Do you want plaintiff, in order to prove the defendant infringes, also to show you that Chemical Process infringes?

The Court: I am not considering it on the question of infringement at all. I am considering it on the validity of the patent. Just that claim. It doesn't have anything to do with whether or not the defendant is infringing your patent. I don't see that it even squints that way. I don't see how any judge could possibly get out of that deposition

I have just heard anything about infringement of the patent.

Mr. Conner: I agree with you.

The Court: I am considering it entirely on the question of the validity of your patent.

Mr. Allen Owen: Your Honor, on the question of the validity of the Grebe-Sanford patent, as affected by the testimony of Mr. Pitzer, you, of course, appreciate it is not prior art against Grebe-Sanford.

The Court: Certainly. I am considering it in connection with why this thing has grown as much as it has, how much is due to the patent and how much is due to other things. That is what I am—

Mr. Allen Owen (interposing): You are considering it on the question of utility, then, of the—

The Court (interposing): No. You have brought into this case the revolution of the art by your patent.

Mr. Allen Owen: Yes, sir.

The Court: And I am considering it on whether or not that claim is true. That is what I am considering it on.

Mr. Allen Owen: In order to hold the Grebe-Sanford patent invalid, then, it would be necessary for Your Honor to find it had no utility; is that correct? In considering such testimony as Mr. Pitzer's.

The Court: You are invoking that well-known rule, and Judge McDermott made very great use of it, in taking a doubtful patent and saving it, because that has just torn the world all up and revolutionized the art. That is all he did. And it is a well-known rule that it is a proper thing to do for a patent that has done that. It is right close to the line, it looks as if it doesn't have any validity or wasn't good. That is what Judge McDermott says, at first blush you would think this patent was not any good, because you have just taken two patents and brought them close together. But he goes on and because this patent, by doing that thing, and bringing the two together, he reaches the conclusion that you have revolutionized the art entirely, and that this wonderful growth is due to this patent. And, if he hadn't, he never would have saved the patent. Now,

here is proof to be considered on that thing, as to whether or not you have this patent—this patent has accomplished this thing that will save a doubtful patent. That is all it is for. You bring in the claim and talk about what you have got in this patent, to save it, is that thing to take that out, and Judge McDermott would have beaten you in a minute, I can see that by reading his opinion, he starts right out by saying that.

But he finds that there is this wonderful thing that has been accomplished by the patent, and that is what saves it. Now, I am re-trying it, the very same issue, exactly, as near as I can see it, it is the same issue, but I have got some additional proof and this is some of it, as I understand it. Here is some proof that he didn't have that it is proper to consider.

Just like I suggested that I was going to be interested all along to learn what has produced this result, how much of it goes to advertising. In other words, suppose you had taken what now, on the face of it, this concern down there has taken, the raw acid, and made a pretty good business out of it.

Now, if Dow Chemical had taken the raw acid and gone into it and advertised it, and with their wonderful fine service that they give to everyone, if they had used that, how far would they have gone? Now, it is the difference between that measures revolution, how good the raw acid and how good a job that will do, and how good and how much is due to the new patent, that you have got to determine in reaching this revolution of the art. Now, I think I have defined the place that this has in the case, and it has nothing to do with infringement. I do not see how I would use it at all. I never thought of doing that and ought not to do it.

WILLIAM A. THOMAS,

a witness called on behalf of the defendant, testified as follows:

DIRECT EXAMINATION

I reside at Mt. Pleasant, Michigan, and have been a geologist for the Ohio Oil Company for two years. Prior to that I was employed by The McClanahan Oil Company and the Pure Oil Company. I left the Pure Oil Company six years ago. Prior to that I was in their employ for twelve years continuously as a geologist.

I had occasion to call on the Dow Company late in 1931 or early in 1932, with reference to a matter involving hydrochloric acid. In December of 1931 I had an idea that acid could be used on lime wells in the Greendale pool. I went over to Dr. Grebe, who was in charge of the research at Dow Chemical, and I might say I was introduced to Dr. Grebe by Ross Sanford.

Mr. Lyon: Before you go into the details of the meeting, I would like to ask you a few questions about the idea that you had before you went there. Where did you get this idea of introducing hydrochloric acid in a limestone formation? A. Being a geologist we quite often use hydrochloric in determining whether it is limestone or whether it is dolomite, and from the samples examined and from knowledge in elementary chemistry I was certain that hydrochloric acid would work on the limestone.

Q. Had you taken this idea up with anyone in the Pure Oil Company, any superior of yours, before you contacted Dow? A. I did.

Q. With whom? A. The chief geologist, Mr. Wasson.

Q. Tell us of your conversation with Mr. Wasson.

A. About one of the first wells drilled in the Mt. Pleasant or Greendale pool, we tried experimenting by use of a bit that would drill horizontally, and this bit was un-

successful and we discontinued it. And, through talking to Mr. Ross Sanford and to Mr. Dow, senior, he was telling me of the hydrochloric acid that they had at that time, and apparently was a drug on the market. In fact, they were neutralizing the hydrochloric with limestone, and that is really the way I got my first idea that we had hydrochloric and I wanted to drill horizontally.

Q. Now, was that idea your own idea or was it some idea that you had obtained from either Mr. Dow or Mr. Sanford or anybody else? A. That was my own idea.

Q. And had you communicated it to Mr. Sanford or Mr. Dow, senior, or anyone else in the Dow Company before you went over for this visit that you referred to a few moments ago? A. I had not.

Q. And before going over to the Dow Company you had communicated it to the chief geologist of the Pure Oil Company? A. That is true, yes, sir.

Q. Were you given any authority, or asked to do anything about the matter by the chief geologist? A. He suggested I would go to the Dow, and knowing Ross Sanford, I went to Ross, who, in turn, took me down to Dr. Grebe's office.

Q. Did the chief geologist suggest that you go to Dow for any particular purpose; if so, what? A. To get the price on hydrochloric acid.

Q. You had known Mr. Sanford before, had you? A. I had, several years, and he took me to see Mr. Grebe.

Q. And up to your meeting with Mr. Grebe had you told Mr. Sanford what you had in mind? A. I told Mr. Sanford what I had in mind and he suggested that I would see Grebe, in charge of the research at that time.

Q. Where was this conversation that you had at this time with Mr. Sanford before you saw Mr. Grebe? A. It was in the outer office near the information booth of the Dow Chemical. As near as I can fix the day, it was about December 20th, or the day before I wrote to Mr. Wasson.

I think the first inquiry I made of Dr. Grebe was the availability of hydrochloric, and he said that they had

plenty. I asked him at that time to tell me how much limestone that hydrochloric acid would dissolve. He had a young chap in the back, who figured out about fifty-six hundredths of a cubic foot per barrel of acid, that is, on 20 per cent strength. During the conversation I discussed the idea of applying this hydrochloric to an oil well. This was suggested by me. It did not come from any of the other people there.

Mr. Lyon: Will you continue and tell us what else, if anything, was said at that meeting? A. I do remember one thing in particular that Dr. Grebe said, that they had tried to acidize sandstone wells, and had built the pressure up high enough to raise the earth. Now, that is one thing that really did stick in my mind; theoretically they could have done it, but he said they naturally did not. I also asked Dr. Grebe to give me a price on carbon tetrachloride, because I was quite in doubt as to whether the acid would react on the limestone without washing the surface, or dissolving some of the paraffin off the surface of the limestone at the bottom of the well. He quoted me prices on that, and, in general, from about fifteen minutes to a half an hour I spent in the office, that was the gist of the conversation that I had with Dr. Grebe at that time.

Q. You stated that this young assistant of Dr. Grebe's worked out the amount of limestone that would react with calcium chloride? A. Yes. I have it in writing. He wrote this out himself, this calculation and gave it to me.

Q. I notice on the back is some brief notation. Will you tell me in whose handwriting that is? A. That is in my own handwriting.

Q. When did you write that on that paper? A. At the first conference with Dr. Grebe.

Q. What does this refer to, your own handwriting? A. It refers to the price of carbon tetrachloride; it weighed 13 pounds per gallon, and they would sell it to us for 7 cents per pound. Hydrochloric acid would cost us from 2 to 3 cents per pound.

(The paper above referred to was offered as DX-300.)

Mr. Sanford was not present during all of this conversation that I had with Dr. Grebe. He left the office after we started discussion. I was accompanied by a scout by the name of George Bell, scout for the Pure Oil Company. He is now superintendent of production of the Smith Petroleum out of Greendale, Michigan.

Mr. Lyon: Was there any other subject discussed that you recollect at that first meeting with Dr. Grebe? A. In general, I discussed the action of the acid on our tubing, or on our bailer, and realizing that some damage would be done I really discussed it because I told him we would use, probably, the old bailer or old tubing, and we would not put enough acid in the well to bring the acid level up to the bottom of the casing. We had something like 60 or 70 feet of open hole, and I really dismissed the action of the acid on the pipe at that time.

Q. Now, following that meeting, what was done about this proposition? A. For the next few days, I waited until I heard from our Chicago office, and I was instructed to go back to Dow to see how we could deliver the acid to the well, and I also asked Grebe if he would furnish a couple of chemists or a couple of men to take samples of our residue to see whether or not we got complete neutralization of our hydrochloric acid on the limestone at the bottom of the hole.

Q. And you wanted the chemists to do what? A. I wanted them to furnish me a chemical analysis of this residue to see whether or not the acid had spent itself, or whether we should leave it in the well longer, or if we had left it in long enough.

Q. And how were they going to get a specimen of that residue? A. Why, they would get that specimen from our bailer or from our tubing after we had applied the acid to the well.

The Court: Well, from our tubing, you mean down the inside? A. Down the inside of the well; yes, sir.

The Court: Pump it up or what? A. We could pump it up, or we could use the bailer and bail it up.

Mr. Lyon: Who did you meet on the occasion of that second visit, if you remember? A. I am not sure whether Ross Sanford was there or not. I couldn't be positive of that. I met Dr. Grebe, but I don't remember whether Ross Sanford was at the second meeting or not. I talked to Dr. Grebe.

The Court: You remember whether there was anyone else there? A. I do not. Because I knew Dr. Grebe at that time and didn't need an introduction.

Mr. Lyon: Do you remember now the subject that was discussed at that second meeting? A. Not in detail; no, sir.

Q. What transpired on this subject following that second meeting with Dr. Grebe?

The Court: Well, now, what was the response? You made a request for two chemists, did you say? A. That is right. And they furnished two chemists at the well.

The Court: All right. In other words, you got what you went after. A. Yes, sir.

Q. Now, how long after that second meeting was it before this operation at the well to which you just referred? A. Well, it was within two or three weeks. I can't give you the exact date.

Q. Can you tell us what the name of the well was? A. I believe it was Fox No. 5 in Section 13, Chippewa Township, Isabella County, Michigan.

Q. And tell us how the arrangements were made in your own company for that operation. A. I went to Dr. Grebe and suggested that we would either take it out in carboy lots or have them furnish a truck to take the acid to the well.

Q. That covers how the acid was to get there, but who made the arrangements as to the work that was to be done at the well outside of what these chemists were to do? A. The Pure Oil production department did.

Q. That was handled by the company's own men? A. Company's own men.

Q. Did Dow furnish anything except the acid and these two chemists? A. Not that I knew of.

Q. Were you actually present when the acidizing was done on the first Fox No. 5 well? A. I wasn't there when the acidizing was done.

Q. Were you present at any subsequent well when it was acidized? A. I was at the third well, Root No. 2 in Section 18, Greendale Township, Midland County.

Q. Tell us who furnished the acid on that well, who was there and what company's men did the work. A. The Dow Chemical Company furnished the acid and the Pure Oil Company did the work—that is, most of the work. They probably helped some on getting the acid there and helped the Pure.

Q. Will you state when, if at all, and under what circumstances there was first any discussion that you heard or participated in relating to the use of an inhibitor in the acid? A. The first time I heard of inhibitor was—I don't know whether it was on the third or fourth well, but it was after the well that I am speaking of. I knew nothing of the inhibitor until the Dow applied it to the acid that they furnished the Pure.

Q. Do you know whether or not the acid furnished by Dow for the first of these wells, the first few of these wells that were acidized by the Pure Oil Company, contained any inhibitor? A. As far as I knew they did not, but I didn't see whether they put an inhibitor in it or not.

Q. Now, just tell us what use was made of this acidizing process after this first well that you were on, the Root No. 2, from then up to June, 1932, by The Pure Oil Company, that you had knowledge of. A. From the third well, that is Root No. 2, most of the application and I might say the planning of putting acid into the well was done by the Petroleum Engineering Department, and I had very little to do from then on with anything having to do with acidizing wells. After the third well was acidized I had very little to do, if anything, with acidizing wells.

Q. You referred to the Petroleum Engineering Department. That was of the Pure Oil Company? A. Pure Oil Company. Mr. Carr is chief engineer.

Q. Now, subsequent to the treatment of that Root No. 2 well, some time after that did you learn of an argument between the Pure Oil Company and the Dow Company as to this acidizing process? A. Well, it was some time along in the spring that the Pure officials were aware that Dow had applied for a patent for inhibitor, and naturally the Pure was very much concerned and they took me over on a couple of occasions to meet with attorneys for Dow and with Grebe. Outside of one instance I wasn't permitted to be in on any of the conferences. I sat in the car at The Dow Chemical Company because they wouldn't produce Grebe and the Pure Oil Company didn't need to produce me.

Q. Did you have a meeting, were you present at one of the meetings, were you actually brought into one of the meetings? A. Not when Dr. Grebe was there; we went out to Willard Dow's home one afternoon for about an hour.

Q. And you say "we," who accompanied you on these visits, or attempted visits? A. Mr. Plummer; he is assistant superintendent of production for the Pure Oil Company; Ed Clagett, manager of the Michigan Division. I don't remember who else was present at that time.

(Here DX-301 and 302 were offered and received.)

The Court: What do you say, Mr. Thomas, about the first you heard about inhibitors? A. Well, it was, at the time I talked to Dr. Grebe and Ross Sanford on the first occasion, I asked them about the action on the pipe, or we discussed that.

The Court: Yes. A. But I dismissed that at that meeting, saying that we were going to use probably the bailer or going to use tubing that it would not hurt if it did affect the pipe, so I didn't pay much attention as to whether or not Mr. Sanford spoke of this chromate. I do not remember it.

Mr. Owen: Do you know whether they did use a bailer at that first treatment? A. I was not at the first well.

Mr. Lyon: What did they use on the Root No. 2 well which was the first one you were at; did they use a bailer or tubing? A. They used tubing, if I remember correctly.

The Court: What is the first memory you have about hearing about inhibitors? You are not sure whether you heard about it at that first meeting, because, as I understand it, you weren't very much interested in whether it ate the pipe or not, because the situation was such you thought it wouldn't eat it. Wouldn't get at it. A. I knew it would eat it, but I didn't think it would hurt it.

The Court: Was it going to be in the acid? A. It wouldn't be in the acid very long. You see, it would just be getting it in the well and getting it out.

The Court: And, after all, while it was in there, you mean, you didn't think it would be in contact. A. I thought our casing was set high enough in the well that it wouldn't get at the bottom part of the well.

The Court: You thought it wouldn't hurt going down and coming up. A. If it did, it wouldn't hurt very much.

The Court: All right. Now, you aren't real clear what was said about inhibitor right then, as I understand; is that right? A. That is correct.

The Court: Well, was the subject up, can you tell me whether or not you discussed acid and its effect on iron and you remember the statement that it wouldn't hurt in your well you didn't think; is that right? A. That is right.

The Court: But you don't remember, as I understand you—don't let me lead you at all—it is my understanding of it you aren't sure whether something was said about if it was going to be in contact with the iron very long it could be protected by the inhibitor? A. No, sir. I wasn't enough of a chemist so I didn't pay much attention to the discussion between Grebe and Mr. Sanford.

The Court: Now, when was the first that you heard them talk about an inhibitor that would prevent the hydrochloric acid from eating the iron? A. About the first I heard of it was from Mr. Carr and he was aware that the Dow had made application for patent for inhibitor.

The Court: And that you say was when? A. I can't give you the exact date. It was some time after.

The Court: You don't know now, I suppose, when they

said they had made application, you don't know whether they talked to their lawyers about it, whether it was actually filed. You would have no knowledge of that kind, would you? A. No.

The Court: Are you clear whether they had applied or were going to apply, any notion at all in between those two? A. I didn't know for certain whether they had applied or whether they were going to apply.

Mr. Lyon: I might state this, if it would be of any help, Your Honor. We do not believe we can unscramble any question here as to whether Grebe and Sanford or whether the Pure Oil Company were the men that first suggested the use of the inhibitor. So we are not going to raise any question about the inhibitor. The point I want to make clear to Your Honor is that this proposition of acidizing a well, call it if you want to a revival of the Frasch patent, wasn't the Dow Company's idea but the Pure Oil Company's idea.

The Court: Do you know how successful it was? You weren't there. You must have heard. You were interested in it. How did it come out? Or were you going to ask that later? I am curious to know how your treatments came out. A. On Fox No. 5, a well making about 3½ barrels a day, and we were ready to abandon the well any way—that was primarily the well we were given to experiment on—after the introduction of this acid it seems to me our production was doubled, or about eight barrels a day. We were still in a quandry as to whether or not it was cleaning up the hole or whether it was the use of the acid at that time. So we took another well. I can't recall whether it was the Thompson well, but our second well to the north in Section 12, was making about 30 barrels a day. We pulled the liner out of the hole, introduced this acid, and the production was stepped up to about 125 barrels a day. Then the third well, the Root No. 2—

The Court (interrupting): What do you mean by "the liner"? A. We had an open hole from the Traverse down to the top of the Dundee about 600 feet. The shale

was falling into the hole. We run a thin pipe in there to keep this caving from going to the bottom of the hole.

The Court: You call that pulling the liner out? A. We pull it out.

The Court: That is, the one you had in there? A. Yes, sir, and cleaned up the hole, and introduced the acid.

Mr. Owen: May I ask whether you pulled the tubing on that? A. Undoubtedly we pulled the tubing in order to get our liner out. We would have to. On Root No. 2 that came in initially for 700 or 710 barrels a day.

The Court: That would be the third well? A. That was the third well. I recall the production at the time we acidized it was about 90 barrels a day—that is before acidization. After the first twenty-four hours it made 790 barrels a day.

The Court: Was the casing in that? A. Yes, the casing was in it.

The Court: Did you take the casing out? A. No, the casing was in but we had no liner in that well.

The Court: The iron casing was in? A. Yes, sir.

Mr. Owen: I think you mean tubing, Your Honor, instead of casing. A. The tubing is removable, the casing is permanent.

The Court: In that second well, was the casing in? A. Yes, sir, the casing was in the second well.

The Court: So the acid came in contact with the iron as it went down is what I am after. A. Yes, sir, I would say so.

The Court: In all of these? A. In all of the wells.

The Court: You see, I had in mind your contention here that if you leave the iron in it doesn't do so good a job of acidizing the well down there in the rock is what I am thinking about. I didn't see how you could take the casing out but you didn't anyway. A. That is true.

The Court: When you took the liner out that left it so the acid went against the casing. A. No, Your Honor, the liner was placed in the open hole above the top of the Dundee. These wells were cased a little bit differently

than we case them today. Our present casing program is to run the pipe from the ground down to the top of the Dundee. In the early days of the Greendale pool we would set our pipe above the Traverse 600 feet above the Dundee, and there was some loose shale in some of the wells that would cave in the hole. In those wells we would set in 300 or 400 feet of liner in there.

The Court: Down below your casing? A. Yes, sir.

The Court: And you would protect that down in there? A. Yes.

The Court: But you didn't take the casing up, but the tubing. A. Second one.

The Court: What about the Root No. 2? A. The Root No. 2 as I remember was the first well we used oil on the outside and on the inside of the tubing in the casing. We filled the hole completely full of oil.

The Court: You don't mean outside the casing. A. Outside the casing, between the tubing. Then our acid followed down the tubing.

The Court: There you had your iron? You had your iron casing? A. Yes, sir.

The Court: You handled it just as you would if there had been an inhibitor in so far as the iron is concerned, so far as the acid coming in contact with the iron? A. Yes, sir.

The Court: You didn't do anything to protect the iron from the acid in the Root No. 2? A. That is true.

The Court: How was the situation as to whether it was a well where it was likely to get in contact, like in Fox No. 5 the situation was such that even though you didn't have any inhibitor in the acid wasn't likely to be long in contact with the iron. What in that regard was the situation in Root No. 2? A. I can't recall, Your Honor, whether they were as careful on Root No. 2 as they had been on the other wells or not.

The Court: It wasn't a case of being careful, as I understood it. It was more a case it happened to be the iron wasn't down in the well on Fox No. 5. A. That is

true. I might add on the first well we were going to junk the well anyway. It didn't make so much difference. Here we had a well making 90 barrels a day and we were a little more careful of spoiling that well.

The Court: Now, the fourth well, tell me how that came out. A. Each well after the first three we had a noticeable increase in production.

The Court: You had a noticeable increase in number 3 I would say. A. From then on we never did have a failure in acid that I recall.

The Court: No. 4 didn't have any inhibitor in it? A. I can't say as to the inhibitor.

The Court: What about No. 1? A. I don't know whether they put an inhibitor in it, or not.

The Court: All right.

Mr. Lyon: Did you order any inhibitor for that well? A. I did not.

Mr. Owen: Did you have charge of the ordering of the acid? A. I had charge of ordering the acid from Dr. Grebe. He said he would get the acid out there. Whether he put in an inhibitor, I don't know.

The Court: Did they charge you for the first well? A. I don't believe they did, because, as a matter of bookkeeping, Dr. Grebe suggested that they would furnish the acid free of charge, and it would save them a lot of bookkeeping; whether he charged the Pure Oil Company, I don't know. He made that suggestion that they would take it out there and charge it up to research.

The Court: How long were you in his office? A. I was in his office from fifteen minutes to a half an hour.

The Court: Your contention is that—I take it that you do not dispute that this witness right here, for the Pure Oil Company, went there to get the well treated—is that right? Do you dispute that? That they took the initiative in that regard? Is that disputed at all?

Mr. Owen: No.

The Court: That this witness went there for the Pure Oil Company and told them that they wanted a well treated, that they had made up their mind to make a trial—

Mr. Owen: I don't know whether they had gone that far; I don't think they had. I think they had it in mind. May I ask Mr. Thomas this question?

The Court: Yes.

Mr. Owen: Did you know of Mr. Sanford's activities in putting acid down their brine wells? A. I did not.

Mr. Owen: You didn't know anything about that? A. No.

The Court: He had not even inquired for him, as I understand it. He was introduced to the doctor. A. Oh, I asked Ross Sanford who I should get in touch with. He was the only man I knew, outside of Mr. Dow, Senior, and Mr. Willard Dow, at that time.

The Court: You had two things in mind to buy when you went there? A. Yes.

The Court: As I understand you? A. Yes.

The Court: Just see if I understood you right. You went there for the sole purpose of buying hydrochloric acid, and carbon tetrachloride to take off that sticky stuff off limestone? A. That is true, sir.

The Court: You got some information as to what you were going to buy, how much you would need to dissolve a certain amount of limestone? A. That is true.

The Court: Now, were there any other than those three things that you went there for, that you went there to get? One was information as to the quantity you would need, and the other things you had in mind were the two articles you talked about? A. Yes.

The Court: Did you notice anything—or, did they advise you as to what this would do? Were you the one that suggested what would clean their rock? A. I asked the question—I knew that carbon tetrachloride was a good solvent for paraffin, and I asked him if he knew of any better solvent at that time, and he said he thought the carbon tetrachloride would be all right. He gave me a price on it, which I thought was a little bit expensive, so I suggested the using of a sinker or something to splice part of it at that time, but I had not—other than that, I went there

for a price on the carbon tetrachloride and hydrochloric acid.

Mr. Lyon: What did you say about the hydrochloric acid, how did that come out? A. I asked them if they could furnish hydrochloric acid, and at what price they could furnish it to the Pure Oil Company.

(At this point DX-303 was offered and admitted.)

The Court: Now, that is the first conference; how do you fix that date? A. About a day or two before the 21st; I think it was the 20th.

The Court: How do you fix that date? A. It was very forcibly fixed in my mind because they had taken me over to see the Dow several times, three or four times, and I never got into conference to tell my story.

Mr. Lyon: We are talking about the first meeting when you went to see Dr. Grebe and Dr. Sanford? A. Yes, that is December 21st, 1931.

The Court: How do you fix that? A. It was fixed very easy in my mind because we went over there so many times to see them and that date was the first letter I wrote to the chief geologist of the Pure Oil Company.

The Court: Have you got that letter? A. The letter was left when I left the Pure Oil Company, in the geological file at Saginaw, Michigan.

The Court: Did you write them before you went over there or right after? A. I went to Dow and the next day I wrote the letter to the chief geologist as to the price of this carbon tetrachloride and how I suggested handling it.

The Court: If you had that letter it would help you fix it, but now your memory about a letter is just as liable to be mistaken as your memory of this, I mean— A. That is true.

The Court: The thing you fix your date by, I haven't got, is the point.

Mr. Lyon: As I understand it, when you were having these meetings with these attorneys, and so forth, in 1932, you fixed that date very definitely from looking at that letter? A. I did, sir.

The Court: Oh, he did have it at that time? A. I did, yes, sir.

Mr. Lyon: Now, in connection with that statement of Dr. Grebe's that on that first meeting you had Mr. Humphrey with you, I believe you have testified that that was a mistake; you did not have Mr. Humphrey? A. I had just Bell with me on the first conference. Not Mr. Humphrey. Mr. Humphrey may have been there on the second or third conference. Humphrey was there at the second meeting, not the first. He had me mixed up with Mr. Humphrey at the first meeting.

Mr. Lyon (reading from DX-303): "Humphrey had made some laboratory tests with samples of oil rock from the Dundee structure in which he had shown that hydrochloric acid would dissolve the rock." You had, had you not? A. Yes, sir.

Q. And you had done that before you went to this meeting? A. Yes, sir.

Q. Before you had talked to Dow or ever heard of Dow making any suggestion about using hydrochloric acid in an oil formation? A. I had examined thousands of samples where we had used hydrochloric acid on either limestone or dolomite up to that time.

The Court: For what purpose? A. In our analysis we can more or less tell from the effervescense whether it is a dolomite or whether it is a limestone. In the field out there we can tell more or less the difference between the Monroe formation and the Dundee formation.

Mr. Lyon: Now, we have a stipulation that it had not been used on any of the brine well treating jobs. It is only a couple of paragraphs, Your Honor (reading): "Mr. Richmond: I offer this stipulation. It is hereby stipulated by and between the parties to this litigation that in all of the work done by The Dow Chemical Company or anyone in its employ or on its behalf prior to February, 1932, no inhibitor of any kind, nature or description was used in connection with the acid used in the treatment of brine wells, and the reports and records of The Dow Chemical Company so show.

"Mr. Owen: The proposed stipulation is accepted."

Mr. Lyon (continuing reading from DX-303): "Grebe states that he described in some detail to Thomas and Humphrey the work that we had done on brine wells in attempts to increase brine production and also for brine disposal through pumping back into old wells." Was that before or after you had told them you were interested in getting hydrochloric acid to introduce into oil formations? A. That was after I asked him for the purchase of this acid and carbon tetrachloride. He made a mention they had tried it out on the standstone wells.

Q. You had already told them you wanted it for penetrating the oil formation? A. Yes, sir.

Mr. Lyon: Now I want to show Your Honor the proposed first write-up for the Grebe-Sanford application. It was written up June 7, 1935. I have it here.

(Here DX-304 was offered and admitted.)

Mr. Owen: That was never signed or sworn to by Dr. Grebe, and never filed with the Patent Office, and the claim that counsel read covered Grebe and Sanford's work on brine wells. If I may at this time I would like to call the attention of the court to another document which counsel found in our files, and which he has not called attention to, and that is the affidavit of Mr. Robert J. Quinlan, which is dated December 5, 1932, Your Honor.

Mr. Lyon: I do not believe that Mr. Quinlan's affidavit is admissible. It is self-serving, and Mr. Quinlan is available right here.

Mr. Owen: It is not self-serving. He is not in our employ.

Mr. Lyon: He is available here. He was in their employ at the time this was written.

Mr. Owen: This is just as much admissible in this record as the other ones that you got out of our files.

Mr. Lyon: No, it is not. We can offer documents that we obtained from their files, but they cannot offer statements of men who were in their employ, who are still alive, and within the jurisdiction of the court. We asked them

before to produce Mr. Quinlan, if they want to rely on this document.

The Court: That letter you read from the Pure Oil Company I don't consider as proof of the things stated in it because I think, while not as to you, as to the Pure Oil it was a self-serving document, and I had that in mind at the time, but I do think it helps show the rabbit tracks, as I talk about, and for that reason it is admissible.

Now, I think this is self-serving, and all of these things that they found there in your office; there may be admissions and they are admissible for them, but I think from the other standpoint they are not proof any more than that Pure Oil Company letter is proof of the things stated in it. I do not think it is. I think it is self-serving. It was held in your office, but I do not think that is proof against you, because there you could not help receiving a letter, and that is self-serving so far as the things stated in it are concerned.

Now, here it is proof that you were in a squabble with them, and then the contract you made may be proof that you thought pretty well of those self-serving declarations they made. Now, you can offer this, one of your own employees, you go and get his affidavit after this squabble is on, I think that is self-serving; you could not offer it in any court, because when they go and find an admission there is lying along beside it a self-serving document doesn't admit it. I do think maybe it will be useful in these tracks again. Here I have got a new track way over there, whether it is the same rabbit or not again, this one is over June 7th, and the last track I have got here is way back quite a long time earlier than that. Now, I find way over in June 7th this unsigned—it isn't an application for a patent, but it evidently was in somebody's mind that it might be, dated June 7th. I think this affidavit may connect up the tracks to that now. So, on that theory I am admitting it, but not as proof of the things stated in it. I am not accepting it as true, but it may help me trace down here this thing, but if you want to prove that this thing is true you will have to call him as a witness. If he was dead,

beyond the jurisdiction of the court, that raises still another question, and the rule is being very much broadened in that regard, but I don't know of any broadening in this regard, the witness right here, a few miles of here, that an affidavit he made for his own boss a few years ago can now be brought in and used instead of his testimony to prove that.

But, I am admitting it as showing this chain of things that led down through to the patent in suit.

The Court: That makes me think what the Patent Office does to us. Now, he could not put that in his tank, he could not take an iron tank and put an inhibitor in and haul it out there without infringing their patent, so he had to go and get a wood tank and carry this in his pocket and put it in after he got out there. That shows what the Patent Office will do to business if you will let them have their way about it.

Mr. Owen: First he went and got the arsenic and then he went to the hydrochloric acid plant and put in 19 inches of water and then he ran into the tank 17 inches of strong 33 per cent hydrochloric acid.

The Court: And if the defendant's patent is any good he had to get a wood tank to haul it out there, isn't that right?

Mr. Owen: That is right.

The Court: That is what sounds so ridiculous to me.

Mr. Owen: That is what they claim.

The Court: Yes. The Patent Office, where they get business—there are people going out there to do their work and they could carry it perfectly all right in an iron tank, but they have to go and get a wood tank to get out there or else carry their inhibitor in their pocket and eat up their iron tank and put it in after they get out there.

Mr. Lyon: Of course according to the plaintiff's patent we would have to get a rubber hose and put it down an oil well.

The Court: Yes, these two patents split business across the grain instead of along the grain, hitching on improvements, it runs right cross grain and inconveniences and

divides it all on the road it would naturally travel through business. You can see right here you have got it split cross ways, and you go and get a wood tank to haul it out when they didn't need a wood tank at all.

(The Quinlan affidavit above referred to was thereupon offered and admitted as PX-305.)

Mr. Lyon: I understand that that is not received except for the limited purpose Your Honor indicated?

The Court: Yes, not proof of the things stated in it.

Mr. Owen: I might say in that connection, in the Williams Brothers record Mr. Quinlan was a witness called by the defendant and he testified substantially the same as he has here.

Mr. Lyon: That part of the Williams Brothers record is not in evidence here either.

The Court: So long as he is available, without stipulation, but they evidently want a chance to cross-examine him, and where a witness is right nearby, I think the court should give them that right to cross examine, and here is a witness that is easily available and because he previously made affidavits or gave testimony, I hold it is not admissible as proof of the things he said, but I do admit it. I will look at everybody's testimony out there in the Tenth Circuit for the purpose of interpreting those opinions out there, so in that way we do look at things.

CROSS EXAMINATION

By Mr. Owen:

Q. I did not quite understand, Mr. Thomas, whether you were claiming that you personally were the one to discover that hydrochloric acid would dissolve limestone, and to suggest the use of hydrochloric acid in an oil well for that purpose? A. As far as I knew, no one had ever tried it before, and it was my own idea that we should try it out there in the Greendale pool.

Q. Did you ever file an application for a patent on it? A. I did not.

Q. Did you know that others connected with the Pure Oil Company had filed applications relating to the method of treating oil wells with acid? A. I knew that Mr. Carr was working on what turned out to be the Carr patent, along in the first part of 1932, yes, sir.

Q. Did it occur to you then that you should file an application on your own idea? A. Well, since I was working for the Pure Oil Company, I was given to understand that anything I found was theirs.

Q. Did they ask you to file an application? A. They did not.

Q. After the first talk with Grebe and Sanford, which you fix as on or about December 21, 1931, what, if anything, did you have to do with securing the consent of the officials of the Pure Oil Company to make a treatment on one of their wells? A. I wrote a letter to Mr. Theron Wasson, who was chief geologist for the company, and he, more or less through his suggestion, got Mr. Carr interested in trying out the treatment of this first well.

Q. Did you discuss it with Mr. Carr in any way? A. Not until after I had written the letter to Wasson; I told him of my ideas, and he said to get that in writing, and get the price of acid and tetrachloride, "And I will see what I can do with the Chicago office."

Q. Did you discuss it with them, with any of the officials or any of your superiors in the Pure Oil Company, before the first treatment was actually made? A. Well, Mr. Humphrey then came into the picture; Mr. Humphrey worked for Carr, and he came into the picture, oh, within four or five days, or a week, and we went over to see Mr. Grebe then together.

The Court: That is the second visit? A. Yes.

Q. And at that time, at that second visit, was anything said about protecting the well tubing and equipment by the use of an inhibitor? A. I don't recall the inhibitor as much as I did on the first talk with Grebe, because Mr. Humphrey did most of the talking on the second visit and I was more or less a listener.

Q. You do recall that on the first visit in December, 1931, Dr. Grebe did suggest the use of an inhibitor? A. I do remember this, that if there was anything brought up on an inhibitor I told him I wasn't so much interested because we were going to use an old bailer and tubing.

Q. And you do not claim to have had anything to do with the suggestion of using an inhibitor? A. I do not claim it.

Q. You did not know they were using an inhibitor until after several treatments had been made? A. That is true.

HOWARD M. NICHOLS,

a witness called by defendant, testified as follows by deposition:

DIRECT EXAMINATION

By Mr. Babcock:

I reside at 102 Henly Road, Overbrook Hills, Pennsylvania, am manager of a refinery of the Atlantic Refining Company, and am over 21 years of age. I knew John W. VanDyke, who in about 1895 resided in Lima, Ohio. We were related by marriage. Mr. VanDyke's wife and my mother were sisters. I lived with him when my mother died, ever since 1891. I was acquainted with a party by the name of Herman Frasch. I did most of the driving and

hauling with the team of horses, and as Mr. Frasch would visit Mr. VanDyke I would go sometimes and meet him and drive him to the refinery or take him where he wanted to go. I first knew Mr. Frasch about 1892. Mr. Frasch was a German and Mr. VanDyke was a Pennsylvania Dutchman. At least, that's what he used to call himself.

I have every reason to believe Mr. Frasch was at that time the chief chemist of the old Standard Oil crowd. I believe he was well educated. He is now dead. Mr. VanDyke also is dead. He died September 23, 1939. They were both interested in the acidizing of oil wells. As I said before, as a youngster in those days I drove Mr. Frasch and Mr. VanDyke about a great deal with our own horse and carriage, and I have driven outside of Lima when they were experimenting with those wells. I went with Mr. VanDyke sometimes two or three nights a week, sometimes every night, sometimes with Mr. Frasch. I have one very good recollection of one of the earliest instances of Mr. VanDyke's acidizing of wells, and that's when he made a bet of a Dunlop hat that he could increase the production of a well by, I'll say some ten or fifteen barrels a day. He was successful in it and he won the bet. I don't know whether you remember it in those days or not, but a Dunlop hat had a label in it which was easily extracted. I took it out and pasted it in a hat which was not a Dunlop hat, and I was proud of the fact. The old gent saw it and he wanted to know when I was buying Dunlop hats. I told him I had taken it out of his, and he gave me hell for trying to be somebody that I wasn't. I got quite a lecture on that. That was an incident in my life that was connected with acidizing of wells, as there were times when some of the old gent's lectures were followed by other things.

As to how extensive the work was, I know that there were in the surrounding territory other people; there was a Mr. Channing Lufkin who was a neighbor of ours in Lima, who I think was connected with the Ohio Oil Company at that time. He had a brother or something, Elgwood; his

son was president of the Texas Company for some time. They are both dead. I know Mr. Lufkin was interested in it because he used to come over and they would sit on the front porch and talk about it. Personally, of course, at that time I had no interest in anything at all, except, you might say, playing stable horses, but I know that work continued over a period of a year or more anyhow. It was around I think 1895 and 1896, as I recall it. I didn't move away until 1898. I'll tell you when that was, that was right after the Spanish-American War. I don't know any of the details of the work that was done there. I mean, for example, what kind of formations they were trying to treat.

The material used in the process was some kind of acid. I knew of at least two or three wells that were treated but beyond that I have no recollection. I was born in 1881; that would be 15 or 16 years old, around that, in 1895 or 1896.

I was out on a well while that well was being acidized by either Frasch or VanDyke or someone under them. I remember this much, when they first started to try to get acid down the well, they had a lot of difficulty. I think first they tried to pour it out of a carboy; then they started to pump it. I do know they had some trouble with the pipes eating out. I have no recollection as to whether they remedied that difficulty or not, only by the old correspondence, which I have referred to lately. I first saw it less than two months ago when it was revealed in Mr. VanDyke's file, I think it was after a visit that you (Mr. Babcock) made here, and I had told you what little I knew about what part I had played with Mr. VanDyke and Mr. Frasch. After Mr. VanDyke died there was this bundle appeared and his secretary, Miss McKain, handed it over to me. I think she is in this building now. Of the papers in this file I can positively identify Mr. VanDyke's signature, and I am pretty sure I can identify Mr. Harper's signature, because I worked in the refinery for some years when Mr. Harper was there, and I knew him very well. In fact, I worked in the shop right with him. He was the boss pipefitter. In-

dependent of this file I know that he did all the pipe work in connection with this work of acidizing oil wells, connecting them up out at the well. Morris was his first name; I never recalled his second name. M. G. were his initials.

I would hate to swear I would recognize Mr. Frasch's signature, but I believe I could pretty near pick it out. I remember Mr. Lufkin and could identify his signature if I saw it.

Mr. Babcock: In the file which the witness has just been referring to, I find a letter addressed to J. W. Van-Dyke, Lima, Ohio, and signed by M. G. Harper, this being two pages. It was marked DX-72.

(The witness examined DX-72 and continued):

I would say that was Mr. Harper's signature. I might say this in connection with some of the signatures, particularly Harper's, that I kept a division of labor book in the Solar Refining Company as a youngster, and I had occasion to—everything that happened with the pipefitting gang always had to be signed by Mr. Harper.

(The witness examined DX-73 and testified):

My own name is on there. It is not my handwriting. That is Howard Nichols that appears in there.

(A memorandum on the stationery of the Ohio Oil Company signed "C. F. Lufkin" was marked DX-74.)

(The witness examined DX-74 and testified):

That looks very familiar to me. I believe that is Mr. Lufkin's signature. I have seen that many, many times.

(A letter dated December 16, 1895, addressed to Mr. J. W. VanDyke, Lima, Ohio, signed "M. G. Harper" was marked DX-101.)

Mr. Babcock: On this exhibit are some pencil markings and also some writing in pen. I will ask the witness to state what he can with reference to that handwriting. A. This is all Mr. VanDyke's writing here (indicating). This part in pencil is in Mr. VanDyke's writing.

Q. Will you read there what you can of the writing in pencil. A. McCarthy was the superintendent at Lima, Ohio. "Mr. McCarthy. This one-inch pipe should take

two coats of paint." The other one is "McCarthy: Please tell the shipper to—" he wanted something charged to him, anyhow.

Q. I will ask the witness if he can identify the signature in ink on that letter. A. It looks very much like Harper's signature written in a hurry.

CROSS EXAMINATION

By Mr. Conner:

I am now manager of the Point Breeze refinery of the Atlantic Refining Company and have been since 1921. I have had very little experience in connection with the production, casing and drilling of wells, except as a boy during the summer I pumped three wells out on a small farm that Mr. ~~Van~~Dyke was interested in, known as the Lininen Farm in Ohio. That was around 1894 or '5.

Mr. Frasch and Mr. VanDyke were both interested in acidizing the wells I referred to. They were working together. I was present when acid was put in some of these wells. That was in 1895 and 1896—about that time. I was about fifteen at that time. I was going to grammar schools and was not familiar with chemistry at that time. I know it was an acid that was put into those wells. They got the acid in carboys. We had an acid restoring plant at the refinery at Lima. I knew in a general way what acid was and how it was handled. I think it was sulphuric they used in those wells; that's what they handled at the refinery, I think; that's what they started with, I think. I have seen carboys there at the well site. I assume there was acid in them. Carboys was the way we handled acid in those days; big glass bottles in square cases; and they had a—I don't know what kind of cork it was—like a mushroom.

Mr. Conner: Do you recall now how the acid was put into the well? A. I think I know. They pumped it in. I know they tried to pour it in to start. Beyond that, I don't know.

Q. Do you know of any preparations they made at the

well relative to preparing the well prior to putting the acid in? A. No.

Q. Then the only acidizing or treatment of wells with acid that you have knowledge of occurred only during the period of 1895 to 1896, is that correct? A. Yes.

Q. How many wells in all did you witness? A. About two or three, near Lima, Ohio. Some of them were out of the state, I think, or farther away from where we would normally drive to. I didn't witness them in any other state.

Q. I think on direct examination you testified to the fact that the lines or the pipes were eaten up by the acid. Will you please explain that, as you recall it? A. Well, I know they were eaten up because they had some difficulty with the lines. I will say this, part of that information come from reading it here, on the rubber coating and these—

Q. What lines were you referring to as having been eaten by the acid? A. I wouldn't like to say; I don't remember.

Q. Where did you get the knowledge that you gave on direct examination that certain lines or pipes were eaten by the acid? A. Probably from hearsay.

Q. Do you knew what if anything was done at that time or subsequently to remedy the attack of the acid on the pipes or those lines? A. Only from what I notice in the files.

Q. What is that? A. Rubber coating and painting with various asphaltic paints.

Q. You testified this morning to numerous exhibits on direct examination which were obtained from a file. When did you first see that file? A. About two months ago. It was after Mr. VanDyke's death, when they were going over his papers. They brought it out. Prior to that it has never been in my possession. I have never been responsible for its safe keeping.

Q. Did you ever receive any letters from Mr. Frasch? A. No.

Q. Did you ever see Mr. Frasch's signature? A. I

probably have, but I wouldn't swear to it, I wasn't familiar with it.

Q. When did you last see Mr. VanDyke, can you state that? A. It was this year; it was around August, 1939; the early part of August of this year.

Q. Mr. VanDyke died in 1939, did he not? A. Yes.

Q. Had he been active in his business up to that time? A. Yes. The last few months he was taking treatments at the hospital for his throat. He had been coming into the office off and on. He was away; the early part of 1939 he was away at the hospital for I think about 114 days, at one stretch.

Q. Did you ever see Mr. VanDyke sign his name to any papers? A. Yes, lots of them. I would recognize his signature. I could also identify Mr. M. G. Harper's signature. I last saw Mr. Harper sign his name in around 1897; 1897, 1898.

Q. Such signatures of Mr. VanDyke as you have identified this morning, when were those signatures made? A. They were all made in around 1895 or '6.

Q. Have you seen Mr. VanDyke's signature since those days? A. Yes.

Q. Have you seen Mr. VanDyke's signature continuously from that time on? A. Right up until now; I have watched it change in its various characteristics.

Q. With reference to these several wells that you said you were present when acid was put into them, will you please explain just what is your complete knowledge of what was done to those wells with reference to not only what was done, but what materials went into those wells? A. Well, my presence at the wells was not as a worker, but as a horse and buggy chauffeur, and therefore I couldn't help but observe and know what was going on because the big chief was always telling me things of what he was doing and what he was trying to accomplish and they were trying to accomplish, increasing the production of the wells by putting acid in the wells to eat the formation, to open up cracks and fissures to let more oil out. I have never made use of that knowledge.

Q. Then you were associated with Mr. VanDyke from the time you were about 15 years old, is that correct? A. No, longer than that. I went to live with him when my mother died in 1891.

Q. Do you know what various parts he may have played in the petroleum business during his lifetime? A. Lots of them.

Q. Do you know whether or not he was ever chairman of the board of the Atlantic Refining Company? A. Yes, sir. He was chairman of the board from 1939 back before the last war, the World War I think. I don't know the exact dates.

Q. Do you know whether Mr. John W. VanDyke was ever president of the Atlantic Oil Producing Company? A. Yes, I think he was president of all of our subsidiaries.

Q. Do you know whether he was president of the Atlantic Oil Shipping Company? A. I say, I think he was president of all of our subsidiaries of which that was one.

Q. Do you know whether he was ever president of the Keystone Pipe Line Company? A. I think so.

Q. Of the Atlantic Refining Company? A. Yes.

Q. Of the Venezuelan Refining Company? A. Now, you are getting into a lot of subsidiaries. It is none of my business—in other words, I wouldn't know much about them.

Q. Of the Buffalo Pipe Line Company? A. I think he was president of all of them.

Q. Do you know whether he was a member of the American Petroleum Institute? A. Yes.

Q. Will you explain, please, Mr. John W. VanDyke's connection, if any, with the Standard Oil Company? A. Well, he was with the old Standard Oil group before the Solar Refining Company was ever built. In fact, he was sent out there to build it. That was at Lima, Ohio. In 1903 he came on here. He was on the managing committee at 26 Broadway while he was general manager of the Solar Refining Company.

Q. What was the proportion of Mr. VanDyke's life

span during which he worked or was engaged in the petroleum and oil business? A. I think about ever since he was 19 years old until—he would have been 90 if he had lived another two months.

Q. Did his association with the oil business entail all of the various branches of the oil business? A. I think he touched pretty nearly all of them throughout his career, including production, refining, marketing, shipping, financing; the whole bag of tricks.

Q. From your association with Mr. VanDyke would you say that he was fully cognizant of the various production problems that arose during his lifetime? A. Yes, sir.

Q. Do you know why Mr. VanDyke employed this acid in these wells at the time you testified about, back in 1896 and 1895—what was his object in using that acid? A. The object of putting the acid down in the wells was to eat the rock formation which I believe around Lima was limestone formation, in the hope that it might eat larger fissures and probably also, those created after a shot of nitroglycerine, have the acid go back to eat a larger crevice in order to admit more oil in the well.

Q. Then he was trying to get more oil out of the well? A. Yes.

Q. Do you know of any other ways in which Mr. VanDyke treated wells in order to increase their production? A. No.

Q. Do you think that if he had done any extensive work other than that directed toward the increasing of the production of wells, you would have known about it? A. Not as a co-worker, but simply as an associate, as one member of the family.

Q. Will you please explain what, if any were your associations with Mr. Herman Frasch during his lifetime? A. Well, only that of a boy, a member of Mr. VanDyke's family.

Q. Do you know whether Mr. Frasch ever did any work directed towards the production of oil from the Ohio oil fields? A. Only in connection with Mr. VanDyke. That is all the knowledge I have of that.

Q. Other than that which you have testified to here this morning concerning the work of Mr. Herman Frasch and Mr. John W. VanDyke, what if any other knowledge do you have concerning these men which would throw light on their attempts to treat oil wells with acid to increase their production? A. I think Mr. Frasch probably got the hunch, as you might call it, from the pumping of superheated steam down the sulphur mines or sulphur wells in Louisiana, and pumping the molten sulphur out. I think he did the same thing with the salt wells up around Cleveland.

Q. That, of course, did not concern the problem of producing oil? A. No, but it did give an indication of which way his mind was working.

REDIRECT EXAMINATION

By Mr. Babcock:

Q. I would like to ask the witness if he knows William Irish. A. Yes.

Q. Will you please state where you first met him and how long you have known him? A. No, I presume Mr. Irish has known me more than I have known him. He knew me when I was born. I have been associated with Mr. Irish for probably the last forty-two or three years, both at the Solar Refining Company and the last thirty-three years here at the Atlantic; he has been retired for a couple years, but I am still acquainted with him. He worked for the Solar Refining Company.

Q. I would also like to ask if you knew a Mr. J. G. Neubauer? A. Yes, sir, very well. I knew him at Lima, Ohio, about the same time as I knew Mr.—oh, from 1891 on; Mr. Neubauer was the auditor out there at that time; he did the soliciting.

Q. Was this work which VanDyke and Frasch did in the acidizing of oil wells done for the Solar Refining Company, do you know? A. I don't know.

Q. Do you know whether Frasch or VanDyke themselves owned the wells upon which the process was performed? A. I don't know; I don't believe they did.

Q. Do you know whether they were ever paid for acidizing any wells for someone else? A. Not of my own personal knowledge, but I believe the process was a commercial one.

Q. Do you have any idea whether they discontinued that or why they discontinued it? A. No.

Q. On your cross examination you mentioned asphalt paint. Aside from any knowledge of what Frasch and VanDyke did, would you know from your experience at the refinery whether that would protect iron from acid? A. It would help.

Q. Do you know in whose possession the file from which all these exhibits were taken has been since Mr. VanDyke's death? A. Well, they were in Mr. VanDyke's personal files up until the time of his deatn, and then they went into the executors' hands—Mr. Colley and Mr. Tuttle.

WILLIAM M. IRISH,

called on behalf of defendant, testified as follows by deposition:

DIRECT EXAMINATION

By Mr. Babcock:

I reside at 1047 Rider's Creek Road, Wynnewood, Pennsylvania, and am a retired corporation executive. Before I retired I was president of the Atlantic Refining

Company from 1927 to 1937. My entire business experience was in the oil industry. Leaving college in 1890, I was employed for a few months with the Acme Oil Company at Olean, New York. Then I went to Lima, Ohio, in the employ of the Solar Refining Company in May of 1891. At that time Mr. J. W. VanDyke was general manager of the Solar Refining Company and I began work under him and continued at Lima with the same corporation until February of 1903 when Mr. VanDyke came to Philadelphia as general manager of the Philadelphia plant of the Atlantic Refining Company. I came with him at that time and continued in the employ of the Atlantic Refining Company under several designations until, as previously stated, I became president in 1927, at which time Mr. VanDyke became chairman of the board.

I knew Mr. Herman Frasch from meeting him first in the summer of 1890 and subsequently many times when he was in Lima for business purposes. I saw him one or more times after I left Lima; I do not recall the particular dates. He was a chemist who invented a process for desulphurizing petroleum products and at the time I have mentioned he was in the employ of the Standard Oil Company for the development of that process and allied problems.

Mr. VanDyke was not a chemist. By training he was an engineer, but absorbed a great deal of chemical information in consequence of his work particularly in the desulphurizing of petroleum products, which was the operation that made the Northwestern Ohio crude petroleum commercially valuable. To the best of my knowledge, Mr. Frasch was a graduate of a German university.

Q. I understand he was called to Lima to work on the particular problem in the refining dealing with the desulphurizing of oil. Is that correct? A. Yes. I don't know how much informal talking you want me to do, but as of the dates we have in mind, the valuable product of petroleum anywhere was illuminating oil. The Ohio wells, the Northwestern Ohio wells—the discovery being made in Lima, Ohio—carried sulphur compounds which when pres-

ent in illuminating oils made those oils non-commercial, producing clouding of chimneys, coating of wicks and odors and so forth, so that the Frasch discovery was a means of desulphurizing the distillates that were used for illumination oils. That was what made the Lima, Ohio, oils commercially valuable.

Q. Did you ever have any knowledge of whether or not Frasch or VanDyke or either of them ever did anything in connection with the production of oil at or near Lima, Ohio, particularly relative to the idea of treating in earth formation with acid or anything of the sort, with the intention to improve the well? A. Yes, I know that in the early 1890's Mr. VanDyke and Mr. Frasch conceived the idea that the porosity of the oil bearing rock in the Ohio area could be increased by subjecting the rock, which was a limestone, to the action of acid. I know that they took out a patent in that connection and that they practiced the art to quite an appreciable extent during the period of a few years.

Q. Do you know what kind of acid they intended to use? A. Hydrochloric acid.

Q. Did either of them ever suggest any other acid, do you know? A. I particularly know VanDyke was anxious to use sulphuric acid. Parenthetically, you probably know that a great deal of sulphuric acid is used in oil refining. It is an acid with which he was very familiar and it was difficult for him to be persuaded that calcium sulphate that was formed was not soluble, and therefore wouldn't make much burrowing in the limestone.

Q. What was Frasch's particular idea with regard to that, if you know? A. Well, Mr. Frasch was a chemist, and he knew, of course, that hydrochloric acid was the natural and best solvent for the purpose intended.

Q. Have you any way in which you can fix a date, that is, just generally state whether it was in the 1890's or 1900 that this work took place? A. From memory, the work was in 1895, 6, 7. It was during Mr. VanDyke's residence in Lima, and while I was associated with him in the employ of the Solar Refining Company.

Q. Do you know whether or not Mr. Frasch or Mr. VanDyke owned themselves or either of them owned the oil wells upon which this treatment was used, or were they owned by someone else? A. To the best of my knowledge neither Mr. VanDyke nor Mr. Frasch were owners of the oil wells in their operations. The acidizing operations were carried on on the wells of producers other than themselves.

Q. Did the Solar Refining Company own those wells? A. No, the Solar owned no wells. To the best of my knowledge and belief, they had nothing to do with these treatments. Mr. VanDyke worked for the Solar Refining Company at that time, or was manager, but this work was something he did for himself, entirely for himself.

Q. Do you know whether he was ever paid or remunerated in any way for this work? A. I am entirely confident that much of the work was on a commercial basis; namely, he was paid for the operation. Of course, I had no personal contact with it, or, I know nothing about the accounting. I am quite confident the acid which was used in these treatments was from the Grasselli Chemical Company of Cleveland. They were the supplier of the Solar Refining Company's sulphuric acid. I have no knowledge as to how much acid was bought for this purpose.

I never saw the operation carried on of acidizing a well. My knowledge of what was being done and what was being thought about was from listening in and, to an extent participating in discussions in the laboratory and statements made to me by Mr. VanDyke on what the work was that they had done in the field. I knew a Morris G. Harper there at that time. He was the pipefitter foreman for the Solar Refining Company. I knew him very well, indeed.

Q. Did you ever discuss this work of acidizing oil wells with him? A. No, probably in the sense your question is asked, I never discussed it with him. I knew he was carrying on the operations. I saw the equipment that was used—got together and used for the purpose as it was prepared for hauling into the field. Principally small pipes or tubing that was used for carrying the acid on to the

horizon level, with some hand pumps having pressure on them to force the acid down the pipes.

Q. Do you have any personal recollection as to what measures were taken, if any, to protect those small pipes or tubing from the acid—from the corrosive effect of the acid? A. From observation, I knew that the pipe that was used was coated with a lacquer or asphaltous acid resisting coating. Its appearance was dark brown to black.

Q. Would you call it a paint or enamel, or something of that sort? A. I referred to it as a lacquer; not technically; it was a coating of paint as—

Q. Where did you see this material, the pumps and tubing? A. On the property of the Solar Refining Company at Lima where they were assembled; the things were assembled for trucking to the field.

Q. Did you ever discuss with anyone the reason why this paint was put on the pipes? A. I have no recollection of discussing it. The purpose was so obvious. The purpose was to protect the steel pipes from the attack of the hydrochloric acid.

Q. Was it known at that time that hydrochloric acid would attack steel pipes if they were not protected? A. I should say that was almost common knowledge.

Q. Was it known at that time whether hydrochloric acid would react with limestone? A. Oh, yes.

Q. Do you have any recollection as to who owned the wells or who this work was done for? That is, could you give us the names of any parties who might have owned wells? A. The one name that comes back to me quite definitely is that of VanCleave, who was an oil producer, but I was about to say I don't know whether they operated leases in his own name or under a company name, and if it was a company name I don't know what it was.

Q. Do you have any knowledge as to whether or not this work, this acidizing of wells was successful. That is, whether it increased the production or whether it ruined the wells, or anything of that sort? A. I know by a report it was considered very successful. They had repeated op-

erations from persons—from producers who employed the process, and I was told by Mr. VanDyke that the records were that the costs of operations were returned to the producers in a number of cases in a very few months through increased rate of production.

Q. Do you have any knowledge as to whether either Mr. VanDyke or Mr. Frasch continued this work after say about 1898? A. I am certain that Mr. VanDyke did not carry on appreciably beyond that date or, at least, not after he moved to Philadelphia.

Q. Do you have any knowledge as to why Mr. VanDyke discontinued this work? A. It would only be a surmise, that other activities with which he had engaged and with which I was casually familiar, were taking his time.

Mr. Conner: Objected to as conjectural, not being based on the witness' own knowledge.

Q. (By Mr. Babcock): You may go ahead and answer, please, Mr. Irish. A. All I was going to add was he found other activities more attractive.

Q. Would you please state what some of the other activities of Mr. VanDyke were at or about that time, if you know? A. At about that time he purchased an interest in a paper mill in Middletown, Ohio, and subsequently acquired the entire interest. I might add that he gave considerable time to the organization and management of that business which he carried on for ten or a dozen years.

Q. Did Mr. VanDyke engage in other activities in addition to that which you have mentioned in the period say from 1898 on for the next eight or ten years? A. Yes, he had investments in a number of directions, to which he gave time and attention.

Q. How wealthy a man was he at that time, if you know? A. I would not feel competent to appraise his wealth at that time.

Q. Well, I didn't mean numerically, exactly, I meant would you consider that he was fairly well to do at that time and had money invested in various activities? A. Yes.

Q. Do you have any knowledge as to whether Mr.

Frasch became interested in other activities during the period say from 1895 to 1905, or along in there? A. I know from hearing Mr. Frasch describe it, that during the period you name he was developing and carrying on the mining of sulphur in Louisiana with the injection of very hot water into the sulphur—underground sulphur deposits and bringing the sulphur up in a molten condition.

Q. Mr. Irish, I believe you have mentioned you knew Mr. Morris G. Harper, at Lima, Ohio? A. Yes. I also knew C. F. Lufkin. He was a resident of Lima and an oil producer, and I think also was affiliated with the Ohio Oil Company during the period about which I have testified, around 1895. I know Howard Nichols very well. Knew him at Lima, Ohio, at about that time. He is the same Howard Nichols that I saw here this morning. I do not recall an A. W. Harmon. I knew Frank Harmon. He was a merchant.

I knew a patent attorney by the name of Charles J. Hedrick. I knew him personally. He took out a patent in about 1906 in the name of VanDyke and Irish; a distillation patent.

I knew J. C. Donnell of the Ohio Oil Company very well. I did not know him during the period about which I have testified, that is from 1890 on up to 1903 or so. I knew of him, but never met him until a subsequent time. I would say ten years later, when he was president of the Ohio Company.

I knew Mr. J. G. Neubauer very well. He was auditor for the Solar Refining Company during all of the years that I was connected with that company and resident in Lima. I have recently been told that he is living somewhere on Long Island. I have forgotten the name of the place.

Mr. Babcock: I have here some papers about which Mr. Nichols testified this morning, and would like the witness to state whether he has ever seen these letters or that file before today. A. I never have seen the DX-72. Probably the same answer will apply to the other. The signature on DX-72 is Mr. G. Harper, and to the best of my rec-

ollection it is his handwriting. I saw his handwriting frequently in 1895 and during that period. The signature was on store room orders and other routine documents.

Q. I will ask the witness to go through the papers which he has before him and which papers have been marked for purposes of identification during the testimony of Mr. Nichols this morning, and point out any other signatures which he recognizes as those of the person which they purport to be signed by. A. I would say that this telegram, Harmon is the original signature. DX-82 was written by Mr. VanDyke's secretary, Miss Burge. DX-87 has Mr. Charles J. Hedrick's signature. DX-89 are the same, Mr. Hedrick's signature. I can not identify the writing in DX-90. It is obviously from Herman Frasch. DX-91 is Mr. Hedrick's. DX-101 has M. G. Harper's signature.

Q. With reference to DX-101, I would like to ask the witness if he can identify any of the initials or writing in pencil on that sheet of paper? A. This pencil memorandum apparently is in Mr. VanDyke's handwriting. It also has the name Mr. McCarthy, whom I knew. He was superintendent for the Solar Refining Company while the titles and activities were not specifically defined on any organization chart, to the best of my knowledge and belief Mr. McCarthy was a mechanical superintendent of the Solar Refining Company while I was supervising the process work. I recognize his signature on the back of the sheet of paper marked DX-101. He has been dead a number of years. DX-102 are Mr. Harper's. DX-105 is Miss Burge's writing. DX-106 is Mr. Harper's. DX-108 are Harper's. DX-109 is Mr. VanDyke's. DX-111 are Mr. Harper's, and DX-113 is Mr. VanDyke's.

Q. During the period from 1895 or within five years either way, were you familiar with the writing and signatures of John W. VanDyke, Morris Harper, and the others whom you have testified here today as being the signatures of those men? A. Yes, with the exception of the signature of Mr. Hedrick, the writing and signature of Mr. Hedrick with which I became familiar about 1906 instead of at the earlier date

CROSS EXAMINATION

By Mr. Conner:

I first knew Mr. John W. VanDyke in February of 1891; that's when I first met him. That was in Lima. I was subsequently associated with Mr. VanDyke in business continuously from May, 1891, until May, 1937, and was familiar with his connection with the petroleum business. He was chairman of the board of the Atlantic Refining Company from 1927 to the time of his death in September, 1939. He was president of the Atlantic Oil Producing Company and was associated with the Atlantic Oil Shipping Company, the Keystone Pipe Line Company, the Venezuelan Atlantic Refining Company and the Buffalo Pipe Line Company. Those are all subsidiary companies of the Atlantic Refining Company and Mr. VanDyke was president of these several companies. He also was a member of the American Petroleum Institute.

Q. What, if any, was Mr. VanDyke's connection with the Standard Oil Company and during what period of time? A. He entered the employ of the Standard Oil Company at Long Island City in the—from hearsay this is—in the early 70's and continued in the employment, located part of the time at Long Island City and part of the time at King's County Oil Works in Brooklyn, until 1886 when he went to Lima in the employ of the Solar Refining Company which was a Standard Oil Company subsidiary.

Q. Then from your own knowledge from the time of 1891 until the time of Mr. VanDyke's retirement, you know of your own knowledge that Mr. VanDyke was actively engaged in the petroleum business? A. Yes.

Q. Dealing with all the various phases of petroleum? A. Yes.

Q. What if any association did Mr. VanDyke have dealing with the production of oil from the earth and the drilling of wells, producing wells and increasing their production? A. From 1891 until 1916 he had no active con-

nection except this acidizing operation which has been under consideration. In 1916 the Atlantic Refining Company organized the Atlantic Oil Producing Company, of which Mr. VanDyke was an officer.

Q. Was the Atlantic Oil Producing Company concerned with the production of oil? A. Yes. It was an Atlantic Refining Company subsidiary organized, as I recall it, in 1916 for that specific purpose.

The first time I met Mr. Herman Frasch was in July of 1890 in Paris, France. Our association thereafter was quite close up to the late 90's. When I was in Lima he was there frequently on business relative to the refining of petroleum, desulphurizing particularly.

From 1891 to 1903 I was the superintendent of the Solar Refining Company supervising their process operations. We were engaged in the refinement of petroleum. I had no occasion to do any work directed towards the production of oil such as drilling wells and the like. The only occasion I have had to do any such work has been in a supervisory capacity since the organization of the Atlantic Oil Producing Company, of which I was an officer. It was organized in 1916, if my memory holds.

Q. You stated on direct examination—I am paraphrasing you, not quoting you—that Mr. Frasch and Mr. Van Dyke applied hydrochloric acid, or acid to a well. Were you present when that was done? A. No. I never saw the operation on a well.

Q. Then how did you acquire your knowledge that such was done? A. By statements of Mr. VanDyke and others.

Q. Do you have any personal records or any records that came to you as an official of the company which would tend to show such an operation of acidizing or treatment of wells with acid at or during that period you testified to from 1895 to 1897? A. No records.

Q. How did you acquire your knowledge as to the structure of these pipes you testified to, I think—again paraphrasing you and not quoting you—which pipes were

coated with asphalt or rubber? A. By seeing the pipes assembled with equipment that was going out to the field for that purpose. I saw those pipes and observed their structure.

Q. Do you know to what purpose they were put and how they were used? A. I know that they were—the purpose that they were stated to be used for.

Q. You did not see them employed in the treating of wells, did you? A. No, I did not see them employed.

Q. I think you also testified on direct examination that such wells as Mr. Frasch and/or Mr. VanDyke may have treated with hydrochloric acid during the period 1895 to 1897—I think you stated that the treatment of those wells was paid for. Will you please tell me how you know that, if you do? A. I trust I stated I was told by Mr. VanDyke that those results were achieved. Of my own knowledge I don't know whether they were paid for or not.

Q. Not having been present when these wells were treated in this period, you don't know whether acid, or hydrochloric acid or what was used in them, is that correct? A. That is correct.

Q. Subsequent to the period of 1895 to 1897 when Frasch and VanDyke were reputed to have treated these wells, what do you know of any operations of a similar nature that were done by these parties or any other parties in connection with treating wells with acid or hydrochloric acid? A. I know of nothing by these parties. Other parties, I know that, have in the past. For many years acidizing has been an operation in the oil fields.

Q. To your knowledge when did that work start? This is subsequent operation you speak of, do you know whether it was prior to, for instance, 1933 or 4, or was it subsequent to 1934? A. I have no way of fixing the date.

Q. I will ask you this, do you know or have you any knowledge of any acidizing or treatment of wells with acid which was done between the years of 1895 and 1932 which was done other than that done by—reputed to have been done by Frasch and VanDyke? A. No. I would have

thought merely from memory that there were operations along about 1929 but I haven't any way of fixing any.

Q. I believe you testified on direct examination that these treatments of wells by Frasch and VanDyke in 1895 and in 1897 were successful. If that is the way you testified, how do you know that they were successful? A. From the same source, statements by Mr. VanDyke and others that I have already said.

Q. Did you ever contact the operators of those wells to ascertain to what degree, if any, success was present? A. No; I have had Mr. VanCleave tell me that it was successful.

Q. This file that was presented to you here this afternoon and which you examined, when did you first see that, Mr. Irish? A. After it was presented here.

REDIRECT EXAMINATION

By Mr. Babcock:

Q. I didn't quite understand just what your testimony was with reference to the Atlantic Oil Producing Company. A. That was organized about 1916 and I was an officer.

Q. Did you know in 1916 that limestone formations in oil wells could be acidized? A. Yes.

Q. Of your own knowledge, did you know that if you had wanted to acidize the limestone formation of a well you could do so? A. I will answer yes.

Q. When did you first gain knowledge, would you say, that that could be done? A. Through the work that was done by VanDyke and Frasch.

Q. Would you say that in 1916 and also in 1897 you knew of a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine in which the essential steps consisted in introducing into the well an aqueous hydrochloric acid solution with some method of inhibiting action of acid upon metals? A. The question is whether I knew of such a method?

Q. Yes. A. The answer is yes, with the reservation

as to the question about inhibiting the acid; I am not clear whether the protection of metal comes under the head of inhibitor or not.

Q. Assuming in the question instead of using the word inhibit I had used the word protect the pipes from the action of the acid, or protect metals from the action of acid, what would your answer be? A. It would be yes.

Q. Did you also have knowledge in 1916 or in 1897 that such a method could be used in increasing the production of oil found in a limestone formation bearing oil, by the use of hydrochloric acid? A. The answer would be yes.

RECROSS EXAMINATION

By Mr. Conner:

Q. Are you familiar, Mr. Irish, with any method of inhibiting the action of acid such as hydrochloric acid on metals? A. Under my conception of the definition of inhibit, I am not familiar with it.

Q. What is your conception of inhibiting? A. Well, it is a neutralizing of action, if I can express it that way, or an action, rather; a protection against it.

Q. Are you a chemist, Mr. Irish? A. I took a degree in chemistry but I never became a chemist.

Q. Are you familiar, Mr. Irish, with the use of inhibitors in connection with acidizing wells as those inhibitors are used today and have been used since 1934? A. No.

ROBERT H. COLLEY,

a witness called on behalf of defendant, testified as follows by deposition:

DIRECT EXAMINATION

By Mr. Saye:

I am president of the Atlantic Refining Company and was acquainted with Mr. John W. VanDyke for twenty years during his lifetime. I am one of two executors of his estate. He died September 13, 1939.

As one of the executors of the estate of John W. VanDyke, deceased, I took possession of his files, records, books, and papers immediately after his death.

Q. Mr. Colley, I hand you a file which contains various written instruments, a great many of which have been marked for identification with letters and figures in this proceeding and regarding which Mr. Howard Nichols has testified. For your information, they have also been testified about by Mr. William M. Irish. I will ask you please to inspect or examine this file which I now hand you and state whether or not those papers and instruments came into your possession as one of the executors of the estate of John W. VanDyke, deceased, and whether or not they were found in his files and are a part of his personal papers and records? A. After examining the file, I recognize them to be Mr. VanDyke's papers which we found in a large wooden chest in an inside room adjacent to his personal office where other of his personal papers were filed. This file has been in my possession as executor since it was found and is now at this time.

CROSS EXAMINATION

By Mr. Conner:

I found these papers in a large wooden chest that stood in an inside room adjacent to his own personal private office. Prior to Mr. VanDyke's death they were in his possession; they were in his offee, in the anteroom.

BESSIE G. McKAIN,

a witness called on behalf of defendant, testified as follows by deposition:

DIRECT EXAMINATION

By Mr. Saye:

I was acquainted with Mr. John W. VanDyke during his lifetime. I was in his employ as secretary from, I think it was December, 1925, until his death, September 13, 1939.

Q. I will ask you to examine a file which I hand you which contains various instruments and documents, and for your information I will state some of them have been identified by certain letters and figures this morning and have been testified about by certain witnesses, and I ask you to state if you ever saw that file before? A. (The witness examined a file.) Yes, I have. To the best of my knowledge, I first saw this file over two years ago. It was then in an old chest personally owned by Mr. VanDyke which he had brought from storage to the little anteroom outside of his office, which was part of his office. It was a little conference room. It was placed in there and Mr. VanDyke and I went through the chest at the time as he wanted to see just what was in it. It had come from Lima; he had brought it from Lima many years before that and this package of papers—it was then in a package—was in the chest. These instruments which I have before me are the personal effects of John W. VanDyke, deceased. They remained in his possession from the time I first saw them until his death. They were in that chest. The chest was locked.

Q. Do you know where they have been since that date? A. Well, now, immediately after Mr. VanDyke passed away, we were cleaning out his effects in the office, going through all his papers. I mean Mr. Tuttle, one of the executors of the estate and I personally went through this old chest and we separated the different subject matters into

different piles, and this was one of them, this acid treatment of wells, and it was either given to Mr. Nichols, the plant superintendent, or to Dr. Delbridge. I am inclined to think it went down to Mr. Nichols and he gave it then to Dr. Delbridge, and Dr. Delbridge went through it, I believe, and then it came back to me to be kept for safe keeping until it was needed. I don't know whether it went to Dr. Delbridge first or Mr. Nichols; one or the other.

Q. At any rate then, as I understand your testimony, with the exception of the persons whom you have just named who may have had possession of the file at some time since Mr. VanDyke's death, the papers and file have been in your possession or in the possession of the executors, which? A. Mr. Tuttle is one of them.

Q. I believe you said it was returned to you. Do you act in some capacity for or with the executors? A. Yes, I am doing the work for the executors on Mr. VanDyke's estate. That is the clerical and stenographic work. Subsequent to Mr. VanDyke's death I have been in active touch with his affairs as secretary or assistant to the executors who are looking after his affairs. Mr. Robert H. Colley is one of the executors. Mr. Tuttle's full name is Robert C. Tuttle. He is not available, he is ill. He has had a slight operation. He is vice-president of the Atlantic Refining Company and a director and he resides here in Philadelphia.

CROSS EXAMINATION

By Mr. Conner:

Prior to Mr. VanDyke's death these papers were under my supervision in so far as keeping the key for this chest is concerned, the chest that contained the papers. When the chest was brought up, Mr. VanDyke and I hunted up the key and opened it up and looked through the papers, and then he gave me that key.

Q. Will you be willing to state that these papers have been under your supervision since about 1936 or 7 until the date of Mr. VanDyke's death? A. I think I would, yes.

That chest was in his office quite a long time, but there wasn't any reason for me to keep a definite date, and I didn't do it.

Q. What actual personal knowledge do you have as to the whereabouts of these papers prior to the time they came under your supervision, before 1936 or 7? A. Well, they were in that old locked chest down, I think it was down in our own basement, in one of the vaults.

Q. Did you see them there? A. No, I didn't. The chest was sent up to the office.

Q. How do you know it was in this basement? A. Well, as I recall it, it is a little hazy in my memory now, but as I recall it, the man who has charge of our supplies in the basement, where we have a place for storage of things, called me up and told me it was there, and Mr. VanDyke said to have it sent up to the office as he wanted to go through it to see just what he did have in it.

Q. Do you actually know who it was that had charge of the papers before they came into your office? A. If I am right that that is where the chest came from, I can give you the name of the man who called and told me that the chest was there. I never saw the papers until they came into the office. After they came into the office that chest was in my care. But prior to that I don't know whose care they were in.

JOHN J. NEUBAUER,

a witness produced on behalf of the defendant, testified as follows by deposition:

DIRECT EXAMINATION

By Mr. Babcock:

I live at Elmhurst, N. Y. I was associated with the Solar Refining Company at Lima, Ohio, from 1886 to 1923, when I retired. I was president of the company from 1911 to 1923. I ran all up the line. I was cashier, auditor, superintendent, assistant manager, then manager and then president.

I knew John W. VanDyke. He was a resident manager of the Solar Refining Company, and I was under his supervision. I first met him in Long Island City. That was back prior to 1879. I worked for the Standard Oil Company and went to Lima, Ohio, in 1886. That is when Mr. VanDyke went there.

I knew Herman Frasch. He was doing a little refining in Petrolia, Canada. I think that is the name. I am not sure, but he had a little refinery there. I met him at Lima. He came there to Lima probably along about 1888. It was a year or two after we went out there. The occasion of his coming there, he had a little refinery there, and, of course, the oil there at Lima was the same, about, as it was in Canada; it had a great deal of sulphur deposits in the oil, and, of course, all refineries at that time were built for illuminating oil commonly known as kerosene oil. Naphtha was a by-product at those times. We used to call gasoline naphtha, and it was a by-product, and refineries were all built for kerosene oils. The Lima oil had so much sulphur in it that we couldn't make any kerosene oil without—after you had lit the lamp a short time, the lamp would all cloud up with the sulphur fumes. We had to eliminate that sulphur to make it merchantable oil, and Mr. Frasch claimed

that he had a process that would eliminate the sulphur, and he made this for the Standard Oil Company, I suppose, and they sent him there to demonstrate that he could do that, and he experimented, and at first we didn't get along very well with the experiments, but, anyway, they had a plant in Cleveland, called the Clark Plant, where they built a couple of stills and experimented, he and Mr. VanDyke together. It was on that occasion that I first met Mr. Frasch.

Q. Did you ever have any knowledge of any treatment of oil wells by Mr. Frasch or Mr. VanDyke? A. Yes. Mr. Frasch claimed or he said that he could use an acid method by forcing the acid down by pressure, and the Trenton rock—the oil there was in what we called the "Trenton rock"—and he claimed he could force that down and eat out the rock. It is a porous rock; the oil rocks are porous, something like a sponge, I suppose, and those get clogged up at times, and he forced this acid down to clean that out and open up this rock so the oil could flow back in again. They began experiments, and we had a man that was a pipefitter in Lima by the name of Morris Harper. He was employed by the Solar, and they sent him down and tried it on several wells with some success, but I heard that there was some of that rock that it didn't work on so well.

Q. Do you recall who told you that? A. That's what I heard, you know, but they experimented and run it for quite a while, but what became of it I don't know, whether they discontinued it or not.

Q. You said Morris Harper did the work, but whom did he do it for, do you know? A. Mr. Frasch and Mr. VanDyke.

Q. What was their relation to each other? A. Harper was employed by the Solar Refining Company under VanDyke.

Q. Were the wells acidized for the Solar Refining Company? A. That I couldn't tell you, whether done for the Solar Refining Company.

Q. Do you know whether Frasch or VanDyke or either of them were ever paid for any of this work by any-

one? A. Not that I know of. At that time I wasn't in a position to know very much. At that time I was simply a bookkeeper and cashier.

Q. Do you know what chemical was used? A. There's a question! I had an idea it was muriatic acid; whether it was hydrochloric I don't know. I don't know whether it was hydrochloric acid, but I think we got,—they got the acid from Grasselli Chemical. They furnished us sulphuric acid; they did all the acid business with the Solar. Whether it was muriatic acid or some other acid I don't know, but I have an idea it was muriatic acid. It was acid all right.

Q. Mr. Neubauer, I have here a certified copy of the File Wrapper and Contents of an application for Letters Patent filed in the Patent Office on June 27, 1895, this being filed in the name of John W. VanDyke, Serial No. 554,182, and which matured into U. S. Patent No. 556,651 on March 17, 1896. In this file I find an oath which purports to be signed by John W. VanDyke and sworn and subscribed to before J. J. Neubauer, notary public. I will ask you to refer to this photostat which I have here and see if you recognize any of the signatures there (handing to the witness)? A. Yes, that is VanDyke's signature, and that is my signature. I was a notary public there at that time.

CROSS EXAMINATION

By Mr. Conner:

Q. Mr. Neubauer, what other business or work have you ever done, other than in connection with the Solar Refining Company, which took you into the field of petroleum? A. I don't think I did anything else,—because I have a sixty-year pin here (referring to a pin in the lapel of his coat).

Q. How old were you when you first went to work with the Solar Refining Company at Lima, Ohio? A. Well, I was born in 1853, and I went to the Solar Refining Company in 1879.

Q. Then you were with the Solar Refining Company

practically all your life? A. Yes. Before that I did a little—I didn't have any special jobs, but practically it has been my whole life in the oil business.

Q. Have you ever done any work in the field producing oil from the ground? A. No; strictly refiner. No production work at all. No drilling of wells.

Q. Do you purport to know anything about production practices and drilling practices? A. No, but the producers were all friends of mine and I heard the talk, but practically I had no personal knowledge of producing.

Q. I wish you would tell me, Mr. Neubauer, just what it was Mr. Frasch and Mr. VanDyke were supposed to have done out there near Lima, Ohio, between the years 1895, we will say, and 1900 in connection with putting acid in wells? Just what is your understanding of what they did? A. They forced the acid down and put a pressure on it. And, of course, left it down there, I suppose—it is my idea only—forced this acid down under pressure and kept it under pressure for a certain time and then released it.

Q. Have you any idea how many wells they worked on? A. No; they did quite a few around 1895. I was never present when any of this work was done.

Q. How do you know that they are supposed to have used acid in this work? A. I know that was furnished through the Solar Refining Company; the Solar furnished acid from the Grasselli Chemical Company, and the talk was acid, and I have an idea of muriatic acid, but I am not sure of that, but it was acid that they put down there.

Q. You were never present to see that work done, however, were you? A. No.

L. C. CASE,

a witness for defendant, testified in Dow vs. Williams as follows:

DIRECT EXAMINATION

I live in Tulsa, Oklahoma, and am employed as a chemist by Gypsy Oil Company. I have been employed by them slightly more than nine years.

I knew of an operation consisting of the treatment of an oil well by the Gypsy Oil Company with hydrochloric acid in 1928. I had nothing to do with such treatment, except I scanned the report from our Pittsburgh laboratory making the recommendations.

I had something to do with treating of oil wells at a subsequent time, in July, 1931. We introduced daily charges of dilute hydrochloric acid and an inhibitor down the casing of the well for the purpose of removing scale from the rods and tubing of the well, and for the purpose of removing any scale from the face of the sand or crevices in the sand at the bottom of the well. The scale we had in mind of removing was calcium carbonate scale. The well was located in the Glenn Pool. I couldn't say what county. I remember these things by location. I believe it is Creek County, either that or Tulsa County.

The process that was followed was the simple dilution of commercial hydrochloric acid with water and adding the inhibitor, and then introducing that solution into a drum at the well head, and that was in turn let out of the drum through a hose some distance down into the casing to prevent the vacuum on the well head from drawing that solution back up out of the pipe, and it was allowed to trickle down the casing. It was calculated that a sufficient charge was put in each day to allow that to go to the bottom of the hole and there come in contact with the scale on the rods and tubing and sand face of the formation. The so-called

inhibitor that we placed in this diluted solution of hydrochloric acid was rodine. That was the inhibitor that had been recommended by our research department in 1928.

Q. Did you ever know of rodine being used in the oil fraternity for any purpose whatsoever prior to the time it was recommended for the cleaning out of this well? A. It had been used in cleaning out of engine jackets that had scaled up with what is commonly known as gyp; it is really calcium carbonate scale due to impure water being used in the boiler, and also working barrels and pump equipment, by immersing the acid inhibitor with rodine.

In common language calcium carbonate is limestone. I have no remembrance of the actual amount of hydrochloric acid we put in this well. It was several gallons. A few gallons, one or more gallons I believe it was, five or more gallons a day of the diluted acid was introduced into the well. It was necessary to introduce more than one gallon because the introduction of only one gallon would not allow it to reach the bottom of the hole; it would dry out on the surface of the casing in going down. Now that doesn't mean we put in more than a gallon of the commercial acid, but a certain amount of acid was taken, for instance a quart of the commercial hydrochloric acid and dilute it with five or six gallons, and that in turn was introduced into the well daily. The inhibitor was poured first into the commercial hydrochloric acid and stirred and then diluted with water in a drum. I noticed whether or not this inhibited hydrochloric acid corroded the drum into which it was placed. I didn't notice any corrosion.

I had no occasion to examine the well that was treated in 1931 at a subsequent time to see whether or not the gyp or calcium carbonate was removed and there was any corrosive effect of the hydrochloric acid upon the equipment, casing and tubing, sustained by reason of that treatment. I ascertained whether or not the calcium carbonate was dissolved or removed only by inference. The well seemed to improve somewhat in its action in regard to pulling jobs made necessary by sealing up of the permanent equipment.

As to production I am not sure, I had nothing to do with any other wells other than the one in July, 1931. ~~I~~ suppose that the well which was treated with this hydrochloric acid into which an inhibitor had been introduced in July, 1931, would be considered of rather shallow depth for this country, about sixteen or seventeen hundred feet. Probably between fifteen and sixteen hundred feet deep.

CROSS EXAMINATION

I was in charge of the chemical laboratory for the Gypsy Oil Company when I went with them some nine years ago, and have been in charge of what laboratory there is since that time.

I have always cooperated with our field engineers. The field problems coming under my supervision, as head of the chemical department, were water treatment for scale prevention; scale removal from all field equipment, including wells and boilers; corrosion of pipe lines, pumping equipment; water shutoff problems in oil wells; miscellaneous odds and ends of inorganic matters. The field division maintained a laboratory aside from mine. I believe that would correctly be called in charge of our chief engineer at the time. This laboratory, as ~~I~~ remember it, didn't have a man in it at all times but was a laboratory that was used intermittently by our engineers and under the direction of the chief engineer. The chief engineer at that time was Mr. H. H. Power. Perhaps he would not plead guilty to being a chemist, but I believe he is a pretty good chemist. I think he had training and experience in chemistry.

I knew of the use of hydrochloric acid in an oil well in 1928. I learned that from two men in the engineering department, R. L. Wright in particular. Mr. R. L. Wright was chief engineer at that time in 1928. He is not with the company now. He mentioned to me that that work was to be done; discussed the report from Pittsburgh making the recommendation. Then I later saw the report in the office of our production department. I did not see the acid used

in this well in 1928. It was on the William Berryhill lease. I believe it was number 8, but I am not absolutely certain. The acid put into the well was hydrochloric acid with the inhibitor, rodine. Five or six gallons of solution from one gallon of acid was put in the well I had charge of myself in 1931. I am fairly certain 177 gallons of commercial hydrochloric acid was put in the first well in 1928.

I believe that the report from Pittsburgh regarding this use of acid was made by Dr. Foote personally to Mr. Henry McGraw, then our vice-president, and it would naturally be in his files, or his successor's files. The report or recommendation coming from Pittsburgh had its origin in Pittsburgh this way—well perhaps I would be presuming in saying how it had its origin. Those men made the research on the action of hydrochloric acid on steel, tested a piece in the presence of the rodine inhibitor, and included therewith the recommendation for the well treatment. Now, what led to their original idea was possibly; probably, even some practice they had noticed out here before they started their investigation. I know of no practice they observed out here before they made this investigation and recommendation. The treatment in 1928 was followed out according to the recommendations made in the report from Pittsburgh. I know of no communication between the office of the Gypsy Company here in Oklahoma and the Pittsburgh offices prior to the written recommendation that came back from Pittsburgh.

I didn't observe this well under treatment in 1928. I didn't visit the site of the well, therefore I couldn't see any drums of inhibitor. I was not at the well site while this treatment was being made in 1928. I didn't see that done at all. I got my information about it from talking to the chief engineer and reading this report. I was present in the treating of the well in 1931. The name of the well I treated in 1931 was the Jacob Anderson.

R. L. WRIGHT,

a witness for defendant, testified in Dow vs. Williams, as follows:

DIRECT EXAMINATION

I live at Wichita, Kansas, and am a petroleum engineer. I was employed by the Gypsy Oil Company from 1924 to approximately 1930. I left the employ of the Gypsy Oil Company in July, 1930, I believe.

While in the employ of the Gypsy Oil Company I was stationed principally at Tulsa. My duties were to help carry on the engineering work which had to be done with the operation and producing of the properties and help develop any new methods or improvements in the operation.

I have a degree of mining engineering from Iowa State College, at Ames, Iowa. I took just an average amount of chemistry for an engineering curriculum. That extends a slight amount into a branch of chemistry beyond what we would call elementary chemistry.

While in the employ of the Gypsy Oil Company I was present at a time when some substance was put into an oil well for the purpose of facilitating the flow of oil. That was in the fall of 1928 or 1929, I just don't recall, that has been some time ago and I could not. I sent a report in connection with that. That well was treated with an inhibited hydrochloric acid, with the ultimate purpose in view of reducing well trouble and perhaps increasing the recovery from the well. I was there and personally had something to do with the measuring out of the rodine which was the inhibitor and adding it to the acid and helped pour the acid into the well. We had hydrochloric acid out at that well site. The rodine was originally ordered from the American Chemical Paint Company. I just happen to remember that name—or the name of the inhibitor because it is such an unusual name, and it had such a terrible odor to it, that

it identified itself as the substance. The rodine was ordered and received in Tulsa and subsequently it was transferred down to the Glenn Pool district and from the warehouse in the Glenn Pool district it was transferred to the well and it was measured out because the acid was received in carboys. We had been instructed and informed as to what the optimum percentage of inhibitor to use would be, and so in order to mix up this proper mixture and because our acid was distributed around in carboys, it was necessary to measure out a certain amount and put it into each carboy. I have charge of this addition of this so-called rodine into these carboys of acid. I was informed as to what to do and while I didn't consider myself specifically in charge of that work, why I helped outline and actually did the work. I don't remember the exact percentage of the total volume of the dilute hydrochloric acid or the rodine we put in, but I do recall that it was quite a small amount, say, oh, probably a quart to ten gallons. At any rate, just a few per cent. The rodine was just measured out into a measuring container which held the approximate amount and then was poured into the acid and the bottles were then agitated so that the rodine was perhaps stirred with a stick I don't recall. Then this mixture was poured into the well or rather lubricated in, so it was put in both the casing and the tubing, as I recall. The purpose of this, there was a considerable trouble from scales in wells in that area, all more or less small wells, and the liner barrel was used. Now the advantages of that was it can be run on ~~the rod, which~~ can be handled in a much quicker time and with less trouble. Now with these liner barrels inserted in the common barrel, when the scale would form it would tend to hang up these liner barrels in just the ordinary common working barrel so that it would be necessary to occasionally go in there and pull the rods, even though the wells did not need pulling, and just unseat this barrel, so when the time came to service that well it would only be necessary to pull the rods rather than have to pull what would be termed a wet stream, which would mean pulling the tubing and rods;

pretty much is a large time saving proposition, and the purpose of this was to partially eliminate this operating trouble of the gyp tending to stick the working parts in the bottom of the well.

This mixture of acid with the inhibitor was not immediately circulated in the well. The well was allowed to stand for some time. I don't recall exactly, it was either perhaps twenty-four or forty-eight hours, and at the end of that time, of course we didn't want to pump hydrochloric acid over into our tanks because of the bad effect on the tankage, so that as I recall the well was circulated until the acid was destroyed by its reaction with the scale, and I recall distinctly that a sample of that oil was taken and the well didn't make much water, but we took a sample of the oil and washed it with water, the idea being that any acid that would be with the oil, while it would not go into solution with the oil would go into solution with some more or less pure water and the presence of hydrochloric acid could be identified by an indicator such as litmus paper.

Of course we were trying to get pipeline oil, but we did not want pipeline oil. The ordinary test for pipeline oil does not include an analysis as to whether or not there was any acid in the oil, and we were testing specifically for an acid, and the important reason why we didn't want acid in the tanks in the oil was because of the effect on the tankage. We worked this acid, circulating it. Now, I wasn't there while that was being done but due to the nature of my work I knew it was done, and I was there when this sample of oil was secured and tested with litmus paper for acid content.

The reason I knew this was rodine, or a substance that was known as rodine, I had no other information other than it was rodine. I don't recall whether there was rodine stamped on the barrel in which it was received or not, but because of the shipping instructions on it and being notified from the warehouse that this drum had come in from the American Chemical Paint Company, why I just naturally assumed it was rodine, because at that time I was familiar

with the correspondence that had occurred between the Tulsa office and the Pittsburgh office regarding rodine and the general plan for the test, and I recall distinctly that I had in my desk at the office four little rings of tubing which were the result of tests made by the research department as to the inhibiting effect of these different percentages of rodine, and I believe there were, I don't know just how many, but I believe there was more than one rodine that was tested.

My signature appears on Plaintiff's Exhibit 152. That is the report which I prepared and signed in connection with this application and putting in of the hydrochloric acid inhibited into that well. I was present while this acid was being introduced.

Prior to that time I did not know anything about an agent called inhibitor. I did not have specific knowledge of them other than just a general information which you might have of reading of metals in school work. The reason we did not wish any of this acid to get into the flow tank, was that we just figured that it would not be a good thing to have in the flow tank, or that is in the stock tanks for the reason that occasionally you get more or less acids or you get oil on you and I had been present on several other occasions where chemicals had been used in the wells and I learned by experience that it was —any time that you were working around a chemical why you should know what to do in case you got any on you, and I knew that hydrochloric acid in oils would be a poor thing and when that oil hit the refinery, even though it was inhibited why it would be a poor thing. We were fearful that the inhibited hydrochloric acid would injure our tanks to a slight extent. We just were not perhaps completely sold on the idea that—we had always been more or less of an impression that when hydrochloric acid and metal got together they would more or less react.

CROSS EXAMINATION

My studies in chemistry included a high school course, a general college course and quantitative and ~~qualitative~~ analysis, not organic—inorganic chemistry. I have known about arsenic just in recent publications that have been in the trade journals describing the use of arsenic as an inhibitor in the present more or less intensive program of acidizing wells, which articles have occurred in the trade journals and discussing among various oil men what hydrochloric acid or rather acid treating is doing towards well potentials. That discussion started and these publications started to appear principally in the last year.

I have been located, or for the last year I have been located up in Wichita and in the State of Kansas. There is considerable lime production and there has been quite a lot of acidizing done up there, and it has just been in the time that I have been in Kansas I would say, or within the last year that I have had numerous conversations regarding acidizing. It was within the last year or about that time that these articles first started to appear in these publications reaching the oil fraternity, the trade journals, Oil and Gas Journal, Petroleum Engineer, and magazines of that nature. There is quite a little acid being used up in Kansas.

I don't know the exact number of producing companies employing that method on their wells, but I would say that most of the companies that have lime production have either acidized or hired somebody to acidize for them. That is with inhibited acid. To the best of my knowledge that is what they used. The procedure is such that anybody was going to acidize a well now I believe they would be more or less foolish not to acidize with inhibited acid. That is my opinion, a general opinion in acidizing oil wells. It is to protect the tubing and casing and metal parts of the well.

I could name some of the major companies that are employing the inhibited acid treatment in their wells. I believe the Gypsy; now I am not positive of that; the Gypsy, and Phillips, Mid-Kansas, and Texas Company; in fact most of

the major companies operating in Kansas are using that treatment and have been for the past year.

Before that time I had heard of arsenic without reference to its use as an inhibitor. I studied about arsenic in my high school work. I recognized it as one of the elements and its qualities and characteristics. I would say that I have known about hydrochloric acid, its characteristic qualities, in high school chemistry, which was along about 1915. I would say that I was familiar with the fact that hydrochloric acid solution, that is dilute acid, would react with limestone to form a carbon dioxide gas and calcium chloride for the past eleven or twelve years. I would say that I have known that arsenic is an inhibitor of hydrochloric acid within the last year. I never heard of that before. The reason is that there was a period of time that I was not in the oil producing country and was sort of out of touch with it and it has just been a matter of a little over a year ago that I came back down into this country and more or less familiarized myself with what was going on. I know that hydrochloric acid is inhibited for other purposes than the treatment of oil wells. Today I was reminded of the fact that it was used in the pickling industry. I recall an incident of a discussion regarding galvanizing, and in the case of zinc and iron or steel it is very essential that the mill scale be removed, and that is done by a pickling process. I would say that I learned of that probably six or eight years ago. That would make it about 1928 or 1926. I don't recall that I knew about it before that. I would say that it was about 1926 that I knew about it. I would say that in 1928 it became obvious to me that it was such a simple matter to inhibit hydrochloric acid with arsenic or some other material having the same characteristics and to employ that acid in the treatment of oil wells to increase production. I would say that it more or less became obvious to me immediately after I acquired knowledge of these different facts. I recall of discussing, I don't recall exactly with whom, but discussing the use of acid to more or less dissolve lime. I recall of an instance, of a particular instance where hydrochloric acid was put in a well for the

purpose of dissolving lime. That, however, was principally for the reason of recovering tools that had been lost in the well, and the idea was that the acid would dissolve the lime and more or less free the tools; that is the tools that were lost in the debris at the bottom of the hole.

I have been engaged in the oil production business in one way or another since 1923. I was originally employed by Empire Oil and Gas Company. I was assigned first to the geological department. However, I was located in a field office where the production department was officed in the same building with us, and discussed with the various production department employees the method of pumping and operating properties.

To increase production, if possible, is more or less accepted as one of the problems in the production department of an oil producing company. However, there are and have been times in which economic conditions have more or less retarded that or delayed it for periods of time.

I don't remember the price of oil in 1926 and say to 1932. I believe the price of oil in 1928 was around $1.50 a barrel for 40 gravity oil. The Seminole field came in I believe along in 1927. It was getting pretty well along in 1928. As I associate the years with the oil production I believe it was going very strong in 1928. The Gypsy Company was operating in Seminole, drilling wells in 1928. I don't remember how many wells they drilled there. I rather imagine that at one time they had twenty-five, somewhere between twenty-five and forty-five wells.

The drilling in the Seminole area was not principally to produce an extra barrel of oil or 100 barrels of oil; it was protection for acreage. I believe that you have the wrong reasoning about why Seminole was drilled in place of going into the older properties. The reason was to protect their acreage there. If we had a forty-acre lease, or that is a company had a forty-acre lease and offsets were being drilled to it it would be nothing more than good business to go in and drill and produce oil in proportion to your neighbors and protect your property in that manner. At that time as I recall proration was in effect in the Seminole area

and it was impossible to run all of the oil, but nevertheless it was done so that there was equity in protection of your lease as compared to your neighbor's lease. That same rule or reasoning did not apply to the Glenpool area. There were no offset requirements in the Glenpool at that time. Glenpool was drilled in 1908, 1909 and 1910, if I recall correctly, and the wells had declined to such an extent that those were just operated part time.

I am now with the Phillips Petroleum Company, and have been with them for a little over a year. As far as I know that company was treating their wells with inhibited acid when I first went with them. I do not know when they started to do this. They are doing it at the present time to a more or less limited extent.

I was informed as to how much inhibitor to use in the acid that was employed in this well in 1928 by reading the report previously submitted here from the Gulf Research Laboratory. As to whether or not this problem of treating the well with acid originated with me or first came to my attention and was spread by me, I will say that I was perhaps present when a discussion was made as to the trouble which we were having and suggesting what could be done to remedy the trouble. I do not recall the exact amount of acid that was used in that well. I can say that there were —just guessing at it I would say probably twenty carboys of acid. As I recall the treatment it was all poured in at one time. The well was producing from the Glenn sand and probably around 1500 or 1600 feet deep. The size of the tubing was two inch. I don't recall the size of the casing, probably either what is termed five inch or six inch.

I do not know how much of an accumulation of gyp there was in the bottom of that well at the time the acid was applied. That is problematical. I have seen samples —on the lower of an inch thick and other places on tubing that would be probably an eighth of an inch thick. I haven't seen instances where gyp entirely filled the space around the rod or between the tubing and casing. The deposition of scale is by nature a slow process and in a well that is operating where the rods are moving up and down

it would be practically impossible for the scale to form so that it completely surrounded that rod. Some of those wells in the Glenpool were pumping twenty-four hours at that time; most of them were not. Pumping at that time was of a nature so that any material in solution in the water or oil could precipitate during the intervals between pumping operations. That is no doubt when, perhaps—well I don't know whether it would be when most of the gyp would be deposited. You just naturally assume that in a quiet—or that is water which has an excess concentration of any salt, the quieter it is why that is more or less conducive I would imagine toward the freeing or deposition of the salt out of the water.

The necessity for simultaneous pulling of the rods and tubes in some instances is that when scale is deposited on your—the outside of the working barrel which is known as a liner barrel and more or less made a bond so that it is hard to get it out of the common barrel which is the container into which it is run and if that is left there for a period of time the sucker rods which are pulling the liner barrel perhaps do not have strength enough—they don't like to pull them in two—they will take a strain—the boys will generally have an idea about how much of a pull they are putting on a string of rods and it is detrimental to rods to overstrain them. That is because of this deposition of gyp. The circulation of acid, the circulation of fluid in the well means pumping the fluid in the well up the tubing and discharging it back into the casing. It was flowed or circulated through the tubing back into the casing—the cycle. We never pumped the acid between the casing and the wall of the well. In the normal pumping of the well that would be impossible. As it runs down, the movement in the recirculating of a pumping well, the fluid that is discharged back into the well travels downward in the annular space between the tubing and the casing it would not come up, it would enter the standing valve on the tubing and go down, and then flow in onto the standing valve below the tubing up through the tubing. The idea of doing that of course was to more generally distribute the acid, for we were at-

tempting also to dissolve any gyp or lime which might have been deposited, on the face of the sand and that would be one of the methods of doing it. The fluid levels in those wells are quite low and the movement of this—or by circulating the fluid why you would get a better chance of the acid attacking the sand. And then another thing, this acid, I don't recall just what it costs but it was bought in small quantities, probably thirty or forty or fifty cents a gallon and the amounts of scale in a well, of course, it is problematical and still is problematical as to just how much there is and the amount of acid used, you take twenty carboys of acid perhaps would not dissolve it—I don't know just exactly but guessing at it I would say that it would not dissolve over probably four or five cubic feet of limestone. I don't know how much of a cavity there was at the bottom of the well in cubic feet; the wells have been shot pretty heavy.

REDIRECT EXAMINATION

The picture marked Figure 2 on page 589 of Defendant's Exhibit No. 297 looks to me like it is a section of tubing removed from a well with the deposit of scale and you will note here on the inside that the thickness of the scale is not as much as on the outside because the barrel and rods have been run through that several times and any scale that would be deposited there by putting the barrel and the rods down through why it would necessarily be small enough to allow them to go through. The width of the thickness of the tubing in that picture is a little bit less than a quarter of an inch. The width of the calcium carbonate formation or gyp scale formation on the outside of the tubing is a quarter of an inch or five-eighths. I would say that on the inside it would be about a sixteenth of an inch or a little more. The purpose of putting this hydrochloric acid in the well such as that of the Glenpool area was to take the gyp off of the tubing.

RECROSS EXAMINATION

The formation in Glenn Pool is sand, silicious sand.

S. C. KISER,

a witness for defendant, testified in Dow vs. Williams, as follows:

DIRECT EXAMINATION

I live near Kiefer, Oklahoma, and am employed as field foreman by Gypsy Oil Company. I was so employed by them in the Glenn Pool field in 1928, 1929 and 1930, the same place I am now. The Gypsy Oil Company treated wells with what we called muriatic acid in 1928, 1929 and 1930. We treated several wells. We run it through the tubing to remove what is commonly known as gyp, and we also used an inhibitor in some of them and some we didn't. We treated the well to remove gyp so we could handle the rods without so many pulling jobs, and possibly chance of removing corrosion off the sand too.

The Court: Do you know what effect it had, whether it did work or not? A. Well, it just eliminated pulling. In one sense of the word it would increase the production because we didn't have so much down time in pulling.

In the wells where they were treated by pouring inhibited hydrochloric acid down the tubing we run it in tubing with patent barrels, liner barrels, and after it stood the proper amount of time we wished for it to we raised this barrel up and let the fluid pass out on the sand in the well. One purpose was to get it out of the tube and another to eliminate gyp in the sand, if there was any there.

I have records or memorandum showing the dates that some of these wells were treated. These are all the records I have, I have them all with the exception of that one, 1928. I seen that one treated but I didn't keep the record. I have some six here.

On November 7, 1930, we treated one on the William Berryhill Number 8; the same well they had reference to; and March 10, 1931, the same well; and on July 29, 1929, we

treated Well No. 9 on the same lease; and William Berryhill No. 11 on September 11, 1929. That particular one was diluted with rodine. William Berryhill No. 26 on August 5, 1929. This particular well, if an inhibitor was used at all, the best I can remember the name, I wrote down here, is armine; some substance that looked to me like bees wax, 10 pounds of it. William Berryhill No. 1 on July 25, 1930, run six carboys of acid without any inhibitor. Sam Vowell Well No. 3, September 30, 1929; that was run without an inhibitor; and Thomas Gilcrease Well No. 22 September 4, 1929, we used rodine as an inhibitor with that well. J. P. Rhodes Well No. 6 September 20, 1929, we used that one without an inhibitor.

They treated one well on the Birdie Sells lease, but I have forgotten the date. I didn't have anything to do with that one. The reason I know they used that inhibitor is that is what I was told it was for. It was a dark brown substance that smelled very badly. I have not since had occasion to see something that I knew was Rodine No. 2 more than what they told me that is what it was. That was the first time I had seen what they said was Rodine No. 2. The acid we put in these wells is what we always carried as muriatic acid and we kept it in stock and used it for other purposes.

CROSS EXAMINATION

I have no record of how much acid was put in the well in 1928, although I knew there was quite a bit went in, but I have no record of it myself. I don't recall about how much; several carboys though at least, I imagine twenty carboys. An inhibitor was used with the acid on just two wells that we treated in 1929, 1930 and 1931, including that armine. Well number 11, William Berryhill is one of them. That was September 11, 1929. The next one is August 5, 1929. That is the one diluted with that armine. I recall how much acid was used on each of these two wells. The memorandum I have been referring to during my testimony

was taken from those books. I kept the record of it myself. That is a complete copy of the record from those books copied this morning. I didn't bring those in. The memorandum I have is just the same thing as the entries in the book. I have read all the memorandum I have before me in connection with these wells. We haven't treated wells with acid for the Gypsy recently. I am still in the Glenn Pool. The last well we treated with acid in the Glenn Pool is the last one I gave you here. That was on July 25, 1930.

It is hereby stipulated that the following narrative of the testimony of

RUSSELL S. KNAPPEN,

taken from the appeal record in The Dow Chemical Company vs. Williams Bros. Well Treating Corporation may be accepted with the same force and effect as if taken herein:

DIRECT EXAMINATION

I live in Tulsa, Oklahoma, and by profession am a geologist and engineer. I work for Gypsy Oil Company and have worked for Gypsy Oil Company for eight and a half years. In 1928, '29 and '30 I was assistant to Henry McGraw, vice-president of Gypsy Oil Company.

At one time Gypsy Oil Company treated wells with hydrochloric acid inhibited against attacking steel. The

first of those treatments was in 1928, I believe on November 12, 1928. That was the William Berryhill No. 8 in Glenpool. The date was November 12, 1928. The mineral acid introduced into that well was hydrochloric acid. The name of the inhibiting agent that might have been put in that acid was rodine. There were instructions given that the content of rodine in the dilute acid was to be four per cent. We got the rodine from the American Chemical and Paint Company, Ambler, Pennsylvania. I believe that was the first time that rodine had been purchased by the Gypsy Oil Company. It was not the first inhibitor, but the first rodine purchase, however. The reason that we purchased rodine at that time was that it was recommended by the research department of the Gulf Oil Corporation in a letter from Dr. Paul D. Foote, director of the research laboratory, transmitting a report written by Dr. B. B. Wescott.

I had used another inhibiting agent in hydrochloric acid prior to the time we used this rodine on November 12, 1928. From 1920 on we purchased Dearborn Chemical's formula No. 134, which is a hydrochloric acid with an inhibiting agent already in the material. We used that inhibited hydrochloric acid to clean the scale out of cylinder blocks of engines, the acid of course removed the calcium carbonate scale and the inhibitor protected the metal of the engine blocks.

Calcium carbonate is the principal constituent of limestone. It is an essential mineral in limestone. It is one of the common constituents of boiler scale. It is also a common constituent of the scale that collects in radiators of automobiles. There are several different scales but it is perhaps the most common constituent.

I have in my possession a report by Dr. Paul D. Foote, making recommendation with reference to using this rodine. Dr. Foote transmitted the report on July 19, 1928, and it was received by the Gypsy Oil Company in Tulsa, July 21st or 22nd in the due course of mail. I am familiar with the contents of that report. The conclusion of the report is a recommendation on page 18 which reads, "I recommend

that the removal of the scale by use of hydrochloric acid and four per cent of rodine number 2, or other inhibitor of equal effectiveness, be tried in one well of the Glenpool." That is the summary of the report. That report contains a rather elaborate discussion of inhibitors, the composition of the inhibitors and the chemical theory on which the inhibitors are based. It refers to the various sources of inhibitors, describes two that appear most satisfactory, and contains a table showing the result of tests of two inhibitors in various concentrations and at various temperatures on the amount of steel dissolved from plates immersed in hydrochloric acid. That report or investigation happened to be made in this way. Mr. C. P. Dimit, who is production superintendent of the Gypsy Oil Company, in February or March—in February, 1928, told me of this problem, and at that time I was a member of the staff of the Gulf Corporation in Pittsburgh. At his request I went—he sent samples of the so-called gyp or scale from the Glenpool well in to Pittsburgh to the research laboratory with the request for a recommendation from the research laboratory of some material which could be used to remove the scale from the wells and the well equipment. Dr. Foote recommended the use of acid plus rodine. In the meantime I had been transferred from Pittsburgh to Tulsa and I believe it was on June 4th, I wrote to Dr. Foote stating that we were very doubtful about the ability of an inhibitor to successfully protect the casing which was very old and in very bad condition, and thereafter Dr. Foote sent us samples of steel tubing some of which had been immersed in raw acid and others in acid containing inhibitors to convince us that we could put this acid into our wells without damage to the casing, tubing and the other equipment.

After the treatment of this first well and prior to June 30th, 1930, there were several other wells treated by the Gypsy Oil Company with this inhibited hydrochloric acid. These wells were all located in Glenpool.

Dearborn 134 was inhibited hydrochloric acid. I am not certain that it was labeled inhibited hydrochloric acid; it was labeled scale remover. I cannot say as to whether or

not other oil companies had used it extensively for the purpose for which the Gypsy used it. I know that the Gypsy made purchases each year from 1920 to 1928. I believe that an analysis of Dearborn 134 to determine whether it was sufficiently inhibited so it might be used to remove calcium carbonate scale without injuring the pump jacks and the cylinder jackets and the wells was made for the Gypsy Oil Company in 1921. We had an analysis and test made at the laboratory in Pittsburgh in 1929—I beg your pardon, 1930, to determine whether it was sufficiently inhibited to protect admiralty metal, which is brass, and much more susceptible to corrosion than steel.

I know Mr. Roy Ginter. In 1921 Gypsy Oil Company paid him a fee for chemical work. The record simply discloses analytical work $15, investigation of organic matter $35; I was not connected with the company at that time, and don't have personal knowledge.

Use of the inhibited hydrochloric acid in the wells of the Glenpool by the Gypsy Oil Company was scientifically successful, but economically unsuccessful, because the acid was costing us forty cents a gallon and we were dealing with small wells at a time when the price of oil was very low. It saved money in the operation of the wells over what it cost to operate them without using the acid. I believe there was some increaase in production by use of this acid rather than our old cleaning-out method, but I cannot put my finger on precise figures because the wells were pumped into a lease tank battery so that many wells were produced into the same tank.

These particular wells were all produced from the Glenn sand. That is a sand.

After this acid had been put into the casing or tubing it was of course pumped out of the well eventually. When it was pumped into the casing of course it went to the bottom of the well and it was there pumped out. Where it was placed in the tubing, as I understand in each case, the valves of the pump were unseated to let the acid run down into the cavity at the bottom of the well to remove scale from the walls of the well. That would be calcium car-

bonate scale, or as a field man calls it, gyp. The same calcium carbonate that is the principal limestone formation. There are other impurities there, but primarily calcium carbonate.

I met a Mr. Cummin with the Dow Chemical Company. I believe it was in October or November of 1930. I was entirely wrong; that was November 28, 1932, Mr. J. A. Cummin called upon me. I understood he was district manager for Dowell, Incorporated. I discussed with him the general subject of acidizing. We did not do any business that resulted in any money changing hands.

There was no suit about this patent at that time. He stated that his company had a patent covering the use of an inhibited acid for treating oil wells and solicited business from me. He claimed that his patent was valid and covered the use of inhibited hydrochloric acid in an oil well. I advised him that the Gypsy Oil Company had used inhibited acid as early as 1928 in oil wells, exhibited to him the report which has been entered here this afternoon, and also our correspondence file, and told him that under those circumstances I did not believe his patent was any good, admitting that I was an engineer and not an attorney.

The Gypsy Oil Company since June 30, 1930, surely has continued to use inhibited hydrochloric acid in oil wells, down to the present date. To my knowledge the Gypsy Oil Company has never been sued by the Dow Chemical Company for alleged infringement. I stated to him that we would continue to use inhibited acid.

(Here the report referred to by the witness was offered and received in evidence as DX-151.)

There are various ways of making hydrochloric acid. Frequently hydrochloric acid in its raw state has impurities in it. Probably the most common impurity is sulphuric acid. Very frequently it has impurities such as arsenic in its raw state. The trade in ordering chemically pure hydrochloric acid certainly does require the arsenic content to be greatly decreased from that usually found in hydrochloric acid. Whether or not in the purchase of commercial hydro-

chloric acid it is a common requirement to limit the arsenic content of the hydrochloric acid first would depend on the purpose for which it was being used. In our service we have never made any specifications. I believe it is generally understood that the general run of hydrochloric acid in the raw state has arsenic present in the solution.

CROSS EXAMINATION

I have been engaged in one capacity or another in the oil business since 1920. I am a sort of a chemist. I am not a professional chemist. I took five or six courses. I went through organic and physical chemistry in the university.

All the chemical problems of the Gypsy Oil Company have come under my supervision since 1928. I did not have such problems submitted to me prior to going with the Gypsy Oil Company.

From 1920 to 1926 I was a member of the Oil and Gas Section of the United States Geological Survey. I wrote papers for the survey on geology and natural resources and mineral resources of an area southwest of Billings, Montana; and another paper on the geology of the Phienic area, Alaska.

Petroleum oil is generally classified as a mineral.

I have also been active in connection with the producing end of the oil business since I joined the Gulf Oil Corporation in 1926.

I did not personally observe any treatment of an oil well with hydrochloric acid during the year 1928. I have never seen an oil well treated with hydrochloric acid. I got my information for my testimony regarding treatment of an oil well with hydrochloric acid as an assistant to the vice-president in charge of the technical work of the company. All the technical reports pass over my desk. This report of the well treatment in 1928 was in writing. I have a copy of it right here. The treatment of this well in 1928 was the first treatment of a well with hydrochloric acid that ever came to my attention. I had never treated a well

with hydrochloric acid, either inhibited or not, prior to 1928, nor had I ever made any investigation of such a treatment. No report of such treatment passed over my desk while I was with the Geological Survey.

The problem on which the recommendations by Dr. Foote and Dr. Wescott were made originated in Tulsa. Mr. Dimit raised the question with me in the course of a visit in 1928. The problem referred to by Mr. Dimit was the large amount of scale which was forming on the face of the sand in the bottom of the wells inside the tubing, on the sucker rods and around the tubing, which made operating conditions difficult and reduced production from the wells. That reference was not made to it in writing. We discussed that in his office. I presume that specific wells were named but the general discussion covered the whole Glen Pool situation. I did not make the request for the investigation by Dr. Foote and Dr. Wescott. The way the organization is handled is that the vice-president in Tulsa corresponds directly with the director of research in Pittsburgh, so I suggested to Mr. Dimit that he take that question up with the research department. He then wrote a letter to our vice-president in Tulsa, who in turn sent a letter direct to the research department in Pittsburgh and transmitted the samples to the research laboratory. Samples of scales and samples of water from wells were submitted with that request. I didn't get the samples of scales but they were taken from the rods or tubing that were pulled from those wells. The water samples were brine from those wells under investigation.

The report or recommendation of Dr. Foote and Dr. Wescott was based upon the request made by Mr. Dimit following his discussion of the problem with me and their laboratory investigation made in Pittsburgh by the research laboratory of the Gulf Oil Corporation of which Dr. Foote was the head and Dr. Wescott in charge of the work. The Gypsy Oil Company is a subsidiary of the Gulf Oil Corporation. The Gulf Oil Corporation is not the same as the Gulf Production Company. The Gulf Production Company is a

subsidiary of the Gulf Oil Corporation, just as the Gypsy is a subsidiary of the Gulf Oil Corporation. The Gulf Production Company and Gypsy Oil Company frequently but not necessarily work together on problems of this kind. That is to say, the Tulsa office controls the Gypsy operations and the Houston office the Gulf Production Company's operations. Many problems will be discussed in one office that are not referred to the other. The problems on which a decision has been made in one division which will be helpful in the other are frequently discussed back and forth between the subsidiaries.

The Dearborn Chemical Company's compound came to my attention I believe in 1929. No, it was on December 12, 1931, I wrote Dr. Foote regarding that. I have known of the Dearborn Chemical Company's selling boiler compound for more than twenty years. That is the first time 124 came to my attention. I had never heard of 124 so far as I know before 1931. I have known of hydrochloric acid being inhibited to prevent its attack on metal about six years. If I had ever heard of that before the incident of this well treatment came up it has now slipped my mind; I don't have any recollection of it.

From the discussion of the trial today I should judge inhibited acid has been employed in connection with the metal pickling business for a matter of twenty-five years. Oh, yes, I have heard of metal pickling before today. I knew of a process in metal pickling before today. I first learned of that I believe in 1929. If I ever heard of metal pickling before 1929 I have forgotten. I didn't learn of that while I was taking my course in chemistry, or in connection with my work in the oil fields. I don't believe I ever heard of metal pickling until 1929. I had experience with inhibiting acid in 1928 but never before that time. I believe that I first learned that hydrochloric acid could be inhibited from that report. No, it was a preliminary letter which came along in April or May of 1928. This knowledge of the use of inhibited hydrochloric acid in connection with the well in 1928 was not confined to me and Mr. Dimit, insofar as the Gypsy organization is concerned.

All correspondence to the executive department is circulated between all the members of the executive department. There were six or eight of us on the tenth floor and the report went down to the production department; went into the engineer's department files; was discussed with Mr. Case, the gentleman that just testified here, our chemist. A copy of Dr. Wescott's report went to our production department. Mr. C. P. Dimit was superintendent of production at that time, in 1928. I presume that report was made a matter of record there in the production department. I wouldn't want to say it was but I presume it was. I believe there is a copy in the production department files. I discussed it with Mr. Case, our chief chemist; with Mr. Wright, with Mr. Smith, division superintendent, Mr. Trax and Mr. Dimit. Also discussed the matter with F. W. Karr.

I don't know of my own knowledge that this 1928 treatment resulted in any increase in production. Some of the boys thought there was an increase and others thought there was no increase except as we procured more continuous operation of the well.

The purpose of giving that well treatment was both to increase the production from the well and also to reduce the amount of operating trouble in the well. If we could remove the scale from the face of the sand we could increase the production. If we could remove the scale from the inside of the rods and tubes and the pump we could decrease the amount of trouble we had with the well. I don't say that I have a better recollection than the man applying that treatment as to the result secured from it as shown on this report of the production department. I didn't see the operation. The record there is the best record of course. If this report said that when the acid treatment was applied the well has pumped satisfactory but the production has not been increased, that was the opinion of the man who did the work, the man who wrote that report. If in this report it says, no pulling jobs have been necessary for gyp trouble, but the time has been too short to draw any definite conclusions as to the effectiveness of the treatment,

what he refers to by pulling jobs is that the scale precipitated from the water inside the tubing, it forms around the sucker rods, pieces of that scale will chip off and fall down into the pump and wedge the valve open so you couldn't pump it. It might be necessary to pull the well to repair the pump. In other cases the scales might accumulate so you couldn't move the rods up and down in the tubing, and it is necessary to pull the rods out in order to clean off that scale. I don't know of my own knowledge whether all those conditions were present at the time.

How much acid was put into the well in 1928 is set out in the report. I didn't do the work and I wouldn't want to testify. I think there are about twelve gallons of acid in a carboy.

I have testified that I have never seen a well treated with acid. It has been done under my supervision but I have never seen a well treated. After this incident in 1928 two wells were treated with hydrochloric acid, inhibited or not, in 1929, also in the Glenn Pool. I am not certain as to whether in those treatments the acid was put down the tubing or down the casing. I believe there was three wells treated in 1929. I don't know how much acid was put in them. I can't tell you how many wells were treated in 1930. It is probably in the files here but it is one of the many details that I don't carry in my mind.

I have a further report relating to these treatments in 1929 and 1930. Here is the report. I don't suppose it is the type or kind you want, June 5, 1931, proposing the treatment of some wells in Glenn Pool; and then following it is a report dated July 10, 1931, discussing the treatment of the well in Glenn Pool, to which Mr. Case referred in his discussion. That report is set out here in some detail. It shows the amount of acid employed. July 1, 35 c.c. of hydrochloric acid, 18 c.c. of rodine and 9 gallons of water. On July 2 the same amount of each. July 3, 36 gallons of water, 1400 c.c. hydrochloric acid, 72 c.c. of rodine. July 4, dropped back to the 9 gallons of water and 350 c.c. hydro-

chloric acid. That would be a little less than 10 gallons for each well treatment.

(Here the report dated February 1, 1929, referred to by the witness was offered and received in evidence as DX-152.)

All that I know about treatment of oil wells by the Gypsy Oil Company with hydrochloric acid, inhibited or not, up to that date is reflected in these reports to which I have referred. I mean to well treatments up to 1931.

This report, DX-152, is not the only report subsequent to the February, 1928, report. The first report that I find here is a letter from Stanley Gill of our Houston office to the Tulsa office giving the analysis of the scale in the Glenn Pool. Stanley Gill signed that report. He is employed by the Gulf Production—no, he is employed by the Mellon Institute for the research laboratory; they had a station in Houston at that time. I judge it was Mr. Flynn who referred this matter to Mr. Gill. There is nothing to indicate why the material was sent generally; simply this letter, inclosed find results from analysis of scale from Glenpool. Then the analysis is set out. It does not say from what part of the well the scale came.

The next report is a letter from Dr. Foote to Mr. McGraw transmitting memorandum by Wescott, recommending the use of acid inhibitor. That is a brief memorandum recommending the use of inhibitor in the acid. On June 1, 1928, Paul D. Foote, director of research Gulf Oil Corporation, wrote Henry McGraw, vice-president Gypsy Oil Company, enclosing this memorandum recommending the use of an inhibitor in the acid.

That is the executive file of correspondence up to some time in 1929. I have in addition our production and engineering department files on the matter of acid treatment also.

Here the files produced by the witness were offered and received in evidence as DPX-153.

As far as I can remember there was just one well treated with acid by the Gypsy Oil Company during the

year 1931. I don't know that any were treated in 1930. There were two treated in 1929 and one in 1928. All of these wells were treated pursuant to the recommendation made by Dr. Wescott of the Gulf Oil Company:

After 1931 the Gypsy Oil Company treated some of its wells with acid, either inhibited or not. The first of the subsequent treatments was made on February 10, 1933. No treatments were made with hydrochloric or other acid, with or without an inhibitor, from July, 1931, to February 10, 1933. The Gypsy Oil Company itself did not make that treatment in 1933 that I refer to. It was made by Dowell, Incorporated, which I understand is plaintiff's subsidiary.

The Dow Chemical Company, or Dowell, its subsidiary, has treated additional wells for the Gypsy Oil Company beyond this one that I referred to. I do not have the information as to how many they have treated up to date. Up to November 17, 1933, the date of this report, they had treated ten. The Gypsy Oil Company itself has treated wells with hydrochloric or other inhibited acid since the 1930 date. Since 1930 and up to the present time the Gypsy Company has treated in the neighborhood of 75 wells. The wells treated by the Gypsy Oil Company were treated in the same general way as were those treated for it by Dowell, Incorporated. We used inhibited hydrochloric acid. That was put right into the formation for the purpose of increasing the production. In some cases that actually increased production in the wells in which it was used; in other cases it did not. I cannot give you the average increase in production as a result of that. I can't give you the increase either in daily production or in ultimate production. That work for the Gypsy Oil Company was under my supervision. I have the reports and can produce them.

Those 75 treatments made by the Gypsy were subsequent to the ones made by Dowell, Incorporated, for the Gypsy Company.

REDIRECT EXAMINATION

There were economic or other reasons why the Gyp Oil Company did not in the year 1928 and '29 further pursue the method of attempting to increase their production with the use of inhibited hydrochloric acid. The cost of acid was approximately forty cents a gallon, making the cost of treatment of any of those wells very high. At that time we had more than two million barrels of Glenpool oil in storage. We foresaw a decrease in the market price and had no desire to increase our reserves and accordingly decided to delay further acidizing operations until we had either a shortage of that grade of oil or a more favorable market.

The reason that Gypsy employed Dowell, Incorporated, to treat certain of their wells was that at that time we did not have our acid treating equipment in shape to do the work; the well was located up in Kansas, remote from the place where we expected to do most of our work and it was cheaper to employ them to treat the well than it was to move our truck and our acid from Seminole.

We have employed others than the Dowell to treat our wells with acid. We have employed the Mid-Continent Chemical, and Independent Torpedo, and the Chemical Process Company. When we employed them it was our understanding that they were to put inhibited hydrochloric acid in our wells. We have learned since that one of those companies did not. It was on that understanding they were permitted to treat our wells. We didn't notice any corrosive effect of the hydrochloric acid after the treatment. We have had no good opportunity to make the inspection.

None of the wells treated by us in 1928 or 1929 or 1930 were in or producing from what is known as a limestone horizon or formation. They were all producing from sand. If the face of the sand was clean there probably would not be any increase in production from treatment with inhibited hydrochloric acid. In this case where we had a scale over the sand we hoped for an increase in production.

RECROSS EXAMINATION

There were two other companies that treated wells with acid other than the Dowell, Incorporated. We understood that all three would use inhibited acid. One company now denies they used inhibited acid in its operation. I don't know whether we have given that company any further business. I don't control the letting of the contracts. I don't watch the details of that. In the treatments made by Gypsy Oil Company itself, they have used inhibited acid.

REDIRECT EXAMINATION

The Mellon Institute is an endowed organization. Its researches are publicly known, and the results of them are available to the public, so that this report which came from the Mellon Institute was available to the public at or about the time that I testified we received it.

RUSSELL S. KNAPPEN,

called by defendant in this cause, testified further as follows, by deposition:

DIRECT EXAMINATION

I am employed by the Gulf Oil Corporation and am the same R. S. Knappen who testified in 1934 in the case of The Dow Chemical Company vs. Williams Brothers Well Treating Corporation before the District Court at Tulsa, Oklahoma. I have reviewed the testimony that I gave in

that case as it appears in the printed record thereof. I wish to make a correction or explanation with respect to my testimony as it appears in this printed record. I think that either the reporter misunderstood or I misspoke myself with respect to the reports of the Mellon Institute. On page 111 of the record under the heading of "Redirect Examination," it appears from the record that I gave the court the impression that any report made by an employee of the Mellon Institute was immediately a public record. I do not understand that that is the case. Many Mellon Institute reports are published but the mere fact that a report is submitted to the director, or is submitted by a fellow of the institute to the sponsor of a fellowship at the institute, does not make that report available to anyone who may desire a copy of it at any time. I have no knowledge as to whether this particular report of Dr. Wescott's was ever published.

That is the only thing of importance that I wish to correct in my testimony given in The Williams Brothers case as it appears in the printed record thereof. I would like to point out that at the time I was testifying in the Williams Brothers case, the matters under discussion had all transpired within six years of the trial of that case. Nearly seven years have elapsed since that time. If my testimony today is at variance with the testimony that I gave in the Williams Brothers case, it will only be because of my faulty memory, and my testimony in the Williams Brothers case should be considered as accurate and my testimony of today inaccurate, if there is a discrepancy.

In my testimony in that case I indicated that the Gypsy Oil Company, or the Gypsy Division of Gulf Oil Company, used two other companies to acid treat oil wells other than Dowell Incorporated. And there I stated, "We understood that all three would use inhibited acid." The other two companies I had in mind at that time were the Independent Torpedo Company and Chemical Process Company. I know that the Chemical Process Company has treated a number of wells for Gypsy or Gulf under my direction, and it is my

understanding that inhibited acid has not been used by the Chemical Process Company since the date suit was filed by The Dow Chemical Company against the Williams Brothers Well Treating Corporation. But I do believe Chemical Process Company used inhibited acid prior to that time. Of course, there are other companies that have treated wells for us since the time of the Dow-Williams Brothers trial, and one of these companies used inhibited acid and it is my understanding that the other company did not. The companies I have reference to are the Morgan Chemical Company of Wichita, Kansas, which treated at least two wells for us. And it is my understanding that they used inhibited acid. The other company I have reference to is the Halliburton Oil Well Cementing Company who have treated wells for us and, so far as I am advised, have not used inhibited acid.

The Gypsy Oil Company, as it was known prior to February, 1937, or the Gypsy Division of Gulf Oil Corporation, as it has been known subsequent to that date, have under my direction acid treated certain of their own oil wells. The Gypsy Oil Company treated several wells in the Glenn Pool area, Oklahoma, with acid long prior to the time when limestone or dolomite wells were treated.

The first acid treatment of a limestone well for Gulf was performed on the Lucy Tiger Well No. 1, in Section 3, Township 8 North, Range 5 East, in the Seminole district, Oklahoma. This well was treated on April 12, 1933. This well was treated by Gypsy employees using Gypsy equipment. In the course of the next 18 months 69 acid treatments were administered to wells by Gypsy employees with Gypsy equipment. Some of these treatments may have been second or third treatments on wells previously treated and I do not know how many individual wells were treated. I believe inhibited acid was used in this work throughout 1933, but subsequent to the filing of the Dow vs. Williams suit Gypsy ceased the use of inhibited acid and treated its wells with uninhibited acid. I do not now regard the use of an inhibitor as necessary to the successful acidization of

an oil well. At the time we started this acidizing work we believed that inhibitor was necessary, but in the course of a year's experience we came to the conclusion that the inhibitor was costing us more money than the damage to the equipment would have amounted to, had we used raw acid. Accordingly, we were at the point of stopping the use of the inhibitor when Dow filed suit against Williams.

I recall why we used inhibiter on the first treatment; it was because of the fear of all oil men that acid would damage the casing, tubing, pump and other equipment in the well. Dr. B. B. Wescott, a fellow of the Mellon Institute, in a report about July, 1928, had recommended the addition of an inhibitor to acid which was to be introduced into any Gypsy oil wells. This is the same Dr. Wescott that is now with the Gulf Research and Development Company. It was due to correspondence with Dr. Paul D. Foote, who was Dr. Wescott's superior, and to Dr. Wescott's reports which were transmitted to us that we used inhibited acid.

I was in charge of whatever acid work was done by Gypsy in the years 1928, 1929 and 1930, endeavoring to carry out the suggestions of Dr. Westcott's report dated about July, 1928, in that I was an assistant to the vice president of the Gypsy Oil Company at Tulsa, Oklahoma. I was in charge of all technical work of this company, and with Mr. C. P. Dimit, who was general superintendent of the company, I discussed these acid treatments and suggested the desirability of making them. With Mr. Dimit's approval, I had direct contact with the chief engineer of the Gypsy Oil Company and with the chief chemist of the company, who was in the geological department. Also, I talked directly with the chief chemist, with the approval of the chief geologist, and while I did not have the power to hire or fire these employees, they did accept every suggestion that I made. I think I can fairly say that I was in charge of this acid work, and the reports on the work all came across my desk. The reports were made to the chief geologist and to the general superintendent, in accordance with company policy, but they were immediately trans-

mitted to me, and of course, there were many telephone reports and conversations concerning this work which I received direct.

The Gypsy Oil Company treated with acid certain wells on the Berryhill lease in the Glen Pool, Oklahoma, and subsequently thereto, treated a well on the Anderson lease in the same oil field to carry out a recommendation made by Mr. Case. The William Berryhill well No. 8 located in the Glenn Pool, Oklahoma, about 15 miles out of Tulsa was treated on November 12, 1928, with 9 carboys of hydrochloric acid, which is approximately 108 gallons of acid, to which was added 4 per cent Rodine. Rodine was an inhibitor which we purchased for addition to the acid to prevent any damage to the well tubing, casing or pump. This well had caused considerable trouble due to the deposition of what is colloquially known as gyp in the well.

The reports on this Berryhill well No. 8 repeatedly showed the deposition of gyp in the well tubing immediately above the pump. The gyp would interfere with the removal of the pump from the well and occasionally pieces of scale, which we call gyp, would break off from the tubing and fall into the pump and interfere with the operation of this well. The records of this well show that the gyp was accumulating in largest volume close to the pump and in decreasing volume upward for a distance of 400 feet above the pump. We have no direct knowledge on this particular well as to whether or not any deposition of gyp occurred on the face of the sand formation of the well, but we assume that there was because wells that deposit gyp in the tubing commonly would deposit gyp on the face of the sand.

I was not present at the William Berryhill well No. 8 or at the Jacob Anderson well No. 3 when either of these wells were treated. As I stated before, 9 carboys of hydrochloric acid with 4 per cent of Rodine were introduced into the casing of the Berryhill well No. 8 on November 12, 1928. The next day approximately 18 gallons of acid with 4 per cent inhibitor were poured down the well tubing. The

well had failed to pump after the acid had been poured down the casing and it was concluded at a conference that probably some gyp loosened by the acid had gotten into the pump. Accordingly, the 18 gallons of acid were poured down the tubing in order to remove gyp from inside the tubing and from the pump. There was some difficulty in getting the well to pump. It was interpreted by all concerned as meaning that there was still gyp or scale in the pump and the rods were lifted and dropped several times in order to force the pump into proper position. Then, an additional carboy and a half of acid, with inhibitor, was added to partly fill the tubing. This acid was allowed to stand in the tubing for a day and then pumping commenced. A report was written on February 1, 1929, stating that since the acid treatment the well had pumped satisfactorily, with no gyp trouble. Previous to the acid treatment, the well had caused trouble because of gypped tubing in March, July, September, and November of 1928.

The Jacob Anderson well No. 3 is located in the Glenn Pool, Oklahoma, not far from the Berryhill well No. 8. The large volume of acid and inhibitor used in treating the Berryhill well No. 8 was expensive. The chief chemist of the Gypsy Oil Company, Mr. L. C. Case, thought that he might eliminate the use of such a large volume of acid and secure equally satisfactory results by putting in small quantities of acid day by day. Accordingly, on July 1, 1931, the treatment of Anderson well No. 3 was started, using approximately 9 gallons of water and 350 cubic centimeters of hydrochloric acid and 18 cubic centimeters of Rodine which is the inhibitor previously mentioned. The plan was to gradually introduce each day this Rodine, acid and water. The treating solution was fed into the well gradually at the end of the day's pumping and was put into the casing of the well with a 17-foot length of hose so that the acid would surely go down the well casing and not be removed from the well by the vacuum which was pulling gas out of the well at all times. The treating solution was dumped into the casing at the end of the day's pumping and allowed to

stand over night in the well. The thought was that this would give ample opportunity for the acid to spend itself in the well and it could be pumped out with the oil and water produced by the well the next day.

We had conferences to determine what treatments were to be administered to these wells. The ultimate purpose in the treatment of the Berryhill well No. 8 and the Anderson well No. 3 was the same, but the thought was that by using a small amount of acid daily in the Anderson well, it would be possible to get away from the very heavy expense involved in a single batch treatment, such as was used on Berryhill No. 8. The production department had objected to the batch treatments, saying that a big treatment, such as was given Berryhill No. 8, cost approximately $260 and that the cost of well trouble in the well over a year or two was considerably less than that amount. Accordingly, we were endeavoring to develop means of treating these wells at a low cost, which would still get away from the well trouble that we were experiencing. There were conferences held in my office prior to each of these treatments, at which conference engineers and a chemist were present. In those conferences, I would not say that I designed the treatment. I took part in the discussion and don't now remember how much I contributed to the program and to what extent. I was simply approving the program, but I called the conference in each case. I was present during the discussion, and I approved the program before it was adopted.

The treatment of the Berryhill well No. 8 was a complete success from the standpoint of well trouble, and there was no subsequent gypped tubing in this well for many months. I do not remember when the first trouble appeared in this well after the acid treatment. The treatment of the Anderson well No. 3 was not successful. We attributed this lack of success to the fact that there was a great deal of gyp on the inside of the casing, on the face of the sand, and that the acid was neutralized or exhausted before the acid got into the bottom of the pump. We considered the possibility of increasing the amount of acid, but finally dropped

the matter because it appeared that again we were running into more expense in treating the well than the cost of the well trouble.

Q. I wish to inquire as to whether there was any particular secrecy maintained in treating any of these wells which your company treated in 1928, '29, '30 or '31, that is, was the method or whatever you did there purposely kept hidden? A. No, it was not.

There was no particular secrecy maintained while treating any of these wells in 1928, 1929, 1930 or 1931. The treatment on these wells was understood by the pumpers on these wells and it was discussed freely throughout the office. There were no instructions given to the purchasing department to keep secret the fact that we were buying either acid or inhibitor for these wells. To the best of my knowledge and belief, our people discussed the matter freely, not only among the company employees, but with any outsiders who might learn what was going on. We had a profit motive for treating these wells as we did and treated them in an endeavor to increase the production of the well. We treated the wells in an endeavor to both reduce the well trouble and expense and also in the hope of removing the scale from the face of the sand and thereby increase the amount of oil that the well would produce.

Rodine was the inhibitor that we generally used and it was purchased by the Gypsy Oil Company from the American Chemical Paint Company of Ambler, Pennsylvania.

Under my direction, some of the Gulf Companies today treat formations other than limestone formations with hydrochloric acid. There have been occasional treatments of wells such as the ones I have described here in the Glenn Pool area where we treated sandstone wells. In addition to those wells, we have treated a number of standstone wells in Illinois and Indiana. These sandstone wells carried considerable lime in the sandstone and the treatment was administered with the thought that by removing the lime from the sand we would enlarge the porous spaces, increase permeability, and increase the fluid production from the wells. These treatments were made with hydrochloric acid.

Q. Is there any difference in the method used in those cases and in the method you employed when treating what might be strictly called a limestone formation?

Mr. Conner: That is going to be objected to until it has been shown that the witness has observed treatments of these additional wells in Glenn pool, Illinois, and Indiana, and was there present and witnessed the treatments and knows of his own knowledge what took place. Until he has done that, he is not qualified to testify what difference there was, and he further is not qualified to testify what difference there is in these later treatments and the earlier treatments, because he wasn't present, hasn't observed, has no first-hand knowledge of even the earlier treatments in the Glenn pool back in the years allegedly made, in 1928, '29, and '30.

Mr. Babcock: Well, I don't believe you understood my question, Mr. Conner. I am now comparing present day treatments of sandstone, having calcareous material in them, with what might be truly called limestone formations.

Mr. Conner: I still think it has not been shown yet in the record, to my knowledge, that the witness was present and observed these later treatments, even though the wells that were treated had any formations having calcareous material.

Q. (By Mr. Babcock): I will ask the witness, have you ever seen a well acidized? A. No, I never have.

Q. You have directed the treatment, is that correct? A. I have. I have instructed our engineers to acidize various wells.

Q. Have you gone into detail with them, as to what methods should be employed? A. I have had repeated conferences as to the amount of acid and the pressure to be used, time that the acid should be left in the pay, or in the well, and the general method of acidizing.

Mr. Babcock: I believe that qualifies you to answer that question, so I will ask the reporter to read it to you again.

The Reporter: Question: Is there any difference in

the method used in those cases and in the method you employed when treating what might be strictly called a limestone formation? A. In treating the Aux Vases, Palestine and Cypress sands in Illinois and Indiana, the method is identical with the method used in treating limestone or dolomite wells. Of course, the treatments in the Glenn pool area have been treatments with very much smaller quantities of acid.

Q. Is there any other difference between the treatments in the Glenn pool area in 1928 or '29 and the treatment you employ today in treating the limestone formation other than the amount of acid used?

Mr. Conner: Same objection as previously made.

A. Yes, in the treatment of limestone wells, almost invariably the hole is filled with oil or with gas, under pressure, whereas in the Glenn pool treatments there was no attempt to fill the hole with liquid and as a matter of fact we could not fill the hole with liquid, because the vacuum then being maintained on all the wells in the pool makes it impossible to fill any well in the pool with liquid.

Q. Those are the only differences, then, between the two treatments?

Mr. Conner: Same objection.

A. That is correct.

CROSS EXAMINATION

So far as I know, no publication has been made of Dr. Westcott's report apart from its being printed on page 587 of the record on appeal in the case of The Dow Chemical Company vs. Williams Brothers Well Treating Corporation.

To the best of my knowledge and belief, the first printed reference to the Gypsy acidizing work done in the Glenn Pool is contained in an article written by M. E. Chapman, which was published in the Oil and Gas Journal of October 12, 1933.

I am by education and training a geologist. The Gypsy oil wells of the Glenn Pool area that I have been dis-

cussing produced oil from the Glenn sand, which is the same as the Bartlesville sand and a member of the Pennsylvanian series. The composition of the Glenn and Bartlesville sands is primarily silica with small amounts of calcium carbonate and clay.

I am familiar with a paper written by Mr. Wilson of the Gypsy Oil Company, in which he discusses the sands of the Glenn Pool and wherein he gives the calcium carbonate content of those sands. I believe Mr. Wilson states that the Glenn Pool sands are 5 per cent calcium carbonate, and from my acquaintance with the Glenn Pool sand I would state that that is approximately correct. I think you might get an occasional specimen of the Glenn Pool sand which would run as high as 7 per cent or 8 per cent calcium carbonate, but 5 per cent would be a fair average figure. I have taken samples of sand from the Glenn Pool and analyzed them in acid to see whether they contained calcium carbonate, and from the reaction of the acid on the sand I estimated that these samples had a calcium carbonate content of from 1 per cent to 4 per cent.

So far as I know, the first well treated by Gypsy in the Glenn Pool with hydrochloric acid, either inhibited or not inhibited, for the purpose of removing gyp from a well was the William Berryhill well No. 8 which was treated on November 12, 1928. So far as I know, there were no other wells similarly treated by Gypsy in the Glenn Pool of Oklahoma during the year 1928. I have no records, reports, or other memoranda which would indicate that any other wells were treated with hydrochloric acid in that year for gyp removal.

I was in charge of this acid work, or directed it, and I am sure that if any other wells were treated by the Gypsy Oil Company in the Glenn Pool to remove gyp during the year 1928 that I would have known about it. So far as I know at the present time, there was only one well treated by Gypsy for gyp removal using hydrochloric acid in the Glenn Pool in 1928. I am confident that that is the only occasion.

During the year 1929 Gypsy treated wells in the Glenn Pool with hydrochloric acid for gyp removal, and an inhibitor was not used on all of them. Inhibitor was used on the William Berryhill well No. 11 treated September 11, 1929, and on the Thomas Gilcrease well No. 22. I will now state the wells treated in 1929 by the Gypsy Oil Company in the Glenn Pool for gyp removal wherein both hydrochloric acid and an inhibitor were employed: These wells were the Berryhill No. 26 treated August 5, 1929; our record is incomplete on this well but it appears that an inhibitor was used; the William Berryhill well No. 11, which was treated on September 11, 1929; in this well an inhibitor was used with the acid; the Sam Vowell No. 3, treated September 19, 1929, in which no inhibitor was used; the Thomas Gilcrease well No. 22 which was treated September 4, 1929, in which an inhibitor was used and the J. P. Rhodes well No. 6 which was treated in September of 1929 and in which no inhibitor was used.

During the year 1929, the Gypsy Oil Company in the Glenn Pool of Oklahoma treated certain wells for gyp removal using hydrochloric acid and an inhibitor. These wells were the Berryhill well No. 26 treated on August 5, 1929; the Gilcrease well No. 22 treated on September 4, and the Berryhill well No. 11 treated September 11; and the other wells that I have referred to as being treated by the Gypsy Oil Company in that area during the year 1929, while they were treated with hydrochloric acid, that acid to my knowledge and records did not contain an inhibitor.

The inhibitor that was used in the treatment of the Gilcrease well No. 22 on September 4, 1929, and the Berryhill well No. 11 treated September 11, 1929, was Rodine. The records show that the inhibitor used in the treatment of the Berryhill well No. 6 on August 5, 1929, was Armine. I have no knowledge of what that material is, and that is the reason I said our record is unsatisfactory. Rodine is sold to us as an inhibitor and was recommended by Dr. Westcott as an efficient inhibitor. I do not recognize Armine as a trade name applied to an inhibitor compound. I do not

know what it is. I do not know, to my own knowledge, whether or not Armine is an inhibitor, for the reason that I do not know what it is.

During the year 1930 the Gypsy Oil Company treated certain wells in the Glenn Pool area of Oklahoma for gyp removal using hydrochloric acid. These wells were the Berryhill No. 1, treated on July 25, 1930, with hydrochloric acid but without an inhibitor, and the Berryhill No. 8, treated on November 7, 1930, but the record is silent as to whether or not an inhibitor was used in this well. I do not know of any wells in the Glenn Pool area of Oklahoma that were treated by the Gypsy Oil Company in 1930 where an inhibitor was used.

During the year 1931 the Gypsy Oil Company treated the Jacob Anderson well No. 3 located in the Glenn Pool area of Oklahoma with hydrochloric acid and an inhibitor to remove gyp from the well.

I don't know of any case where the Gypsy Oil Company treated a well in 1932 with an inhibitor. If such a well had been treated, it would have come to my attention, but in the nine years that have elapsed I could have forgotten it. However, I have no record of any such well.

I was not present at the treatment of any of these wells in the Glenn Pool area that I have referred to, covering the period from 1928 to 1932. I have not been present even to this date when any well was being treated with hydrochloric acid for any purpose. The testimony that I have given, both on direct and cross examination, with reference to the treatment of wells is based solely on letters, reports, memorandums, and possibly oral conversations that I received.

After the Gypsy Oil Company treated the Anderson well No. 3 located in the Glenn Pool, Oklahoma, in July of 1931, wherein hydrochloric acid and an inhibitor were used, the next well that the Gypsy Oil Company treated or had treated using hydrochloric acid, inhibited or otherwise, was, so far as I know, the F. A. Lovett well No. 1 in Section 24, 19 South, 2 West, located in the Ritz Canton Pool in Kansas,

which was treated on February 10, 1933. The well was producing from the Viola lime, a member of the Ordovician series. I would hesitate to say whether or not that formation would be limestone or dolomite. We make no distinction in our reports and well studies. I think in all probability this is dolomite rather than limestone. It is a calcareous formation, as distinguished from a sand formation, such as is found in the Glenn Pool.

This Lovett well No. 1 was treated by Dowell Incorporated and that is the first well that I know of that was treated by or for Gypsy using hydrochloric acid after Gypsy treated the Anderson well No. 3 in July of 1931. There may have been other wells treated at Glenn Pool just as Mr. Kiser treated our wells in 1929 without instructions from the office, but so far as our office records go, the Lovett well No. 1 was the first well treated after the Anderson well No. 3, between which treatments there is a time interval of approximately 19 months. I do not have any records or information which will show that Gypsy either treated or had treated for them any wells using hydrochloric acid, inhibited or not, during this period of 19 months extending from the date of the treatment of the Anderson well No. 3 in July of 1931 to the treatment of the Lovett well No. 1 on February 10, 1933.

I have information concerning the treatment of a Gypsy Oil Company well known as the P. Wieland well No. 1. According to our records, this well was treated for Gypsy by Dowell Incorporated in March, 1933. This well was located in Section 36, 12 South, 16 West, Kansas, and was producing from the Oswald lime, which is a limestone in the lower portion of the Pennsylvanian series in Western Kansas. Our records further show that Gypsy Oil Company's well known as the L. Tiger well No. 2 was treated on March 10, 1933, by Dowell Incorporated. This well was located in Section 3, Township 8 North, Range 5 East of the Seminole district, Oklahoma, and was producing from the Hunton limestone, of probable Devonian age.

We ordered inhibited hydrochloric acid placed in the

Lovett well No. 1, the Wieland well No. 1 and the Tiger well No. 2, when they were treated by Dowell Incorporated for the Gypsy Oil Company.

After the Gypsy Oil Company's Lovett well No. 1 was treated on February 10, 1933, by Dowell Incorporated using inhibited hydrochloric acid, the first acid treatment made to an oil well by the Gypsy Oil Company to a well producing from dolomite or limestone was performed on the Gypsy Oil Company's Lucy Tiger well No. 1, located in Section 3, Township 8 North, Range 5 East, of the Seminole district, Oklahoma, which treatment was performed on April 12, 1933. This well was producing from the Hunton lime and was an offset well to the Tiger well No. 2 which Dowell previously treated on March 10, 1933. The treatment of the Tiger well No. 2 by Dowell Incorporated increased the production from 2 barrels of oil to 10 barrels of oil, and the treatment of the Tiger No. 1 by Gypsy increased the production of that well from 102 to 350 barrels. The treatment of the Wieland well No. 1 by Dowell Incorporated raised the production from 45 to 140 barrels. The Lovett well No. 1 treated by Dowell was increased from 95 barrels of oil to 650 barrels of oil daily production.

As far as I know, the Lucy Tiger well No. 1 treated by Gypsy on April 12, 1933, and the Lovett well No. 1 treated by Dowell on February 10, 1933, were treated in identical fashion. There may have been differences in the amount of acid used.

Prior to the treatment of the Gypsy Oil Company's Lovett well No. 1 on February 10, 1933, by Dowell Incorporated with inhibited hydrochloric acid, there is no prior case, based on my knowledge or records, of the Gypsy Oil Company's treating a well producing from a calcareous formation. From the date of the treatment of the Lovett well No. 1, producing from a calcareous formation, on February 10, 1933, the Gypsy Oil Company has continued to have many of its wells which produce from a calcareous formation treated with acid.

Dowell Incorporated have treated a number of wells for the Gypsy Oil Company since February 10, 1933. Dur-

ing the period of from February 10, 1933, to 1936, Dowell Incorporated treated in those years more than 25 per cent of the wells treated for Gypsy. Over the eight-year period of from 1933 to 1941, Dowell Incorporated has treated between 25 per cent and 30 per cent of the Gypsy Oil Company's calcareous wells treated for the Gypsy Oil Company. The figure I gave you of 25 per cent to 30 per cent was made by a count of our records yesterday afternoon, and according to my best information it is a correct figure. If you want the exact numbers, then Dowell Incorporated made 348 acid treatments for the Gypsy Oil Company out of a total of 1,314 treatments in that period of from February 10, 1933 to 1941. The total figure of 1,314 treatments includes all treatments made to Gypsy wells, whether they were made by service companies or by Gypsy Oil Company.

As to the work done by the Gypsy Oil Company in the Glenn Pool area in the years 1928 to 1930 for the purpose of removing gyp from oil wells, we do not have detailed records reflecting the success or nonsuccess of the gyp removal treatments made to these wells on which I can rely because the wells pumped into a common tank battery with all the other wells on the lease. Our record of success is primarily a record of decreased trouble on the well rather than a record of increase in fluid production. The opinion of some of the field men is that the fluid production did increase.

Whenever, for any reason, a well is not producing its normal volume of fluid daily, or does not pump the normal number of hours daily, we say that the well is in trouble and some repair on the well is indicated. That trouble may involve broken sucker rods, it may involve a bad pump, it may mean that there is something wrong with the engine or some of the other equipment, but well trouble means some difficulty in the operation of the well, and gypped tubing is one of the common types of trouble in the Glenn Pool area resulting in the necessity of pulling the pump, sometimes of pulling the tubing also, in order to clean out the scale, or else remove the scale with acid.

I have no actual run records to show the oil production from any of the wells treated in the Glenn Pool for gyp removal during the period of 1928 to 1931 wherein hydrochloric acid and inhibitor was used, which would show whether or not the production of oil from these wells was increased because there was anywhere from 4 to 16 wells on each of these leases and all of the wells produced into a common tank. The only information as to how much oil is produced from any one well is the judgment of the pumper and I do not trust that judgment sufficiently to wish to testify about it.

I have examined the printed record on appeal in the case of The Dow Chemical Company vs. Williams Brothers Well Treating Corporation within recent days, and especially with respect to pages 331 to 465 wherein are contained a series of letters, memorandums and reports concerning the gyp removal activities of the Gypsy Oil Company in the Glenn Pool area, extending over a period of years beginning about 1927 and ending substantially about 1932. The reports all came to me. There is some correspondence that did not pass over my desk.

The letters and reports appearing in the record on appeal in the case of The Dow Chemical Company vs. Williams Brothers Well Treating Corporation on pages 331 to 465 are the best reports, but not the only reports with respect to the wells treated in the Glenn Pool area by the Gypsy Oil Company during the period 1928 to 1931.

The various pumpers of the Gypsy wells in the Glenn Pool area have advised me that the use of the acid with the inhibitor increased the production, but I do not have information which I consider sufficiently reliable so that I wish to testify about it. Some of the pumpers and men in the field offered to me the statement that these tests wherein hydrochloric acid and inhibitor were used to remove gyp did increase the production of the well. Other of these men offered me the information that such treatment did not increase the production of the well. It is because of that conflict in report and because of my knowledge that

there was inadequate information that I do not want to make a statement as to whether there was increase or otherwise in production.

A copy of Dr. Wescott's report which appears on page 587 of the record on appeal in the case of The Dow Chemical Company vs. Williams Brothers Well Treating Corporation was submitted to Mr. C. P. Dimit, who was then general superintendent of production for the Gypsy Oil Company. A copy of the Westcott report was also submitted to Mr. L. C. Case, chief chemist of the Gypsy Oil Company. Mr. Dimit's copy was transmitted by him to Mr. R. L. Wright, chief production engineer for the Gypsy Oil Company and this copy was then transmitted by Mr. Wright to Mr. F. W. Karl, who was a chemical engineer on Mr. Wright's staff. I do not know whether or not Mr. F. R. Smith, who was division superintendent for the Gypsy Oil Company in charge of Kansas and northern Oklahoma wells, ever saw the report or not. To my knowledge, I know that the Westcott report was seen by W. B. Wilson, chief geologist; by Henry McGraw, vice president and general manager of the company; by K. Winship, who was assistant to the vice president; by Rush Greenslade, who was another assistant to the vice president, and by Mr. S. C. Kiser. I suspect that the report was seen by a good many others too but those are all the men I can name that I now know saw the report. I might add that Mr. M. E. Chapman, who was my assistant, also saw the report.

Mr. Conner: Were these men who saw this report, in the aggregate, qualified as geologists, chemists or production engineers, or working on production problems? A. Well, the general superintendent, the production engineer, were certainly qualified. The chief geologist is not a qualified production man. The vice president and the two assistants to the vice president that I named are not geologists, but well acquainted with production problems.

I know that the Gypsy Oil Company, prior to 1928, owned and operated oil wells wherein the oil was produced from a calcareous or limestone formation, which wells were

located in Kansas and Oklahoma. In Kansas, the Gypsy Oil Company had 20 wells producing from a limestone formation which were located on the Shumway lease at El Dorado, and we had one well on the George Jennings lease and one well on the Martin lease in the Rainbow Bend Pool. So far as I can ascertain, these are the only calcareous formation wells which were producing oil prior to 1928 in Kansas. The Gypsy Oil Company still owns and operates at the present time many oil wells which are producing oil from a calcareous or limestone formation, and these wells are located in the states of Oklahoma, Kansas, New Mexico, Illinois, Michigan and Kentucky. The Gypsy Oil Company from prior to 1928 up to the present date, owned and operated oil wells which produced oil from calcareous or limestone formations. We have wells on the Shumway lease at El Dorado, Kansas, which were producing oil in 1926 and are still producing. We have one well in the Glenn Pool area in Oklahoma on the Albert Gray lease which was producing from a lime formation before 1928 and is still producing, and we have one well in the St. Louis district of the Seminole Pool, Oklahoma, which was producing oil from a lime or dolomite formation before 1928 and is still producing. I cannot name any others.

With reference to wells treated by the Gypsy Oil Company after the filing of the suit by The Dow Chemical Company against the Williams Brothers Well Treating Corporation, I never took any samples of the acid as it was being introduced into the well or just prior to its introduction to determine whether or not it was inhibited. I never saw a well treated and I never took a sample of acid. I know that such samples were frequently taken. I gave instructions to take a sample of acid from every well that was treated over a period of three years' time and they were taken and reported to me.

REDIRECT EXAMINATION

From 1928 to 1931, the Gypsy Oil Company treated some half-dozen or more wells for gyp removal. We would not have continued to do that if we had not thought it was doing some good. We felt sure that we were accomplishing the desired results. Our question was whether it was saving us enough money to justify the work.

I was not in 1929, nor at any time prior thereto, familiar with the patent to Frasch No.-556,669.

RECROSS EXAMINATION

During the years 1928 to 1931, the Gypsy Oil Company treated four or perhaps five wells in the Glenn Pool area of Oklahoma for gyp removal, using hydrochloric acid and an inhibitor. The last date on which a well was treated using hydrochloric acid and inhibitor for gyp removal during that period was on July 9, 1931. And thereafter until February 10, 1933, so far as I know, no other well owned or operated by Gypsy was treated for any purpose using either hydrochloric acid or hydrochloric acid and an inhibitor. I should modify my previous statement. The record I was looking at was incomplete. I said July 9, 1931, was the date of the last treatment. The actual date was July 20, 1931. That difference is probably not material. There was a period of 18 months and 21 days during which no treatment was made insofar as I know.

REDIRECT EXAMINATION

After the period of 18 months and 21 days, we began employing Dowell Incorporated, the Independent Torpedo Company and Chemical Process Company to acid treat wells for the Gypsy Oil Company. We first employed Dowell Incorporated on February 10, 1933; we first employed the Independent Torpedo Company on March 3, 1933, and we first employed the Chemical Process Company on March 26, 1933.

BLAINE B. WESCOTT,

a witness called by defendant, testified as follows:

DIRECT EXAMINATION

I am in the position of chief of materials and production, chemistry division of the Gulf Research Laboratory. I have been associated with the Gulf Research Laboratory ever since their organization. It started as a fellowship in Mellon Institute in the summer of 1927. The fellowship at Mellon Institute was installed by the Gulf Oil Corporation as a production fellowship in the summer of 1927 and it continued functioning as a fellowship of the Mellon Institute until, I believe, January 1, 1930, when the production research department of the Gulf Production Company at that time was organized. We then moved to our new laboratories on Craft Avenue. Since that time, it has been known as the Gulf Research & Development Corporation and subsequently as the Gulf Research & Development Company. I have been continuously doing research for one or the other of these companies all during that period.

I have a doctor's degree in chemistry, obtained from the University of Pittsburgh in 1923. I did work in connection with the steel industry prior to 1927, beginning first in 1912. I can't say definitely, but it was approximately 1920 when I first heard, to the best of my recollection, of the use of inhibitors to protect metal from the action of acid, such as hydrochloric acid. I know such inhibitors were in common use in the steel industry prior to 1927.

I made the report beginning on page 587 of the printed record of the case entitled "Dow Chemical Company vs. Williams Bros. Well Treating Corporation," which was before the Tenth Circuit Court of Appeals of the United States, Case 1285. I have the original report from which this printed record was taken.

(The report was introduced in evidence as DX-151.)

This report was made approximately June 5, 1928, or slightly before that. I don't know exactly the right date on which it was completed. The letter which is printed on page 344 of the Williams Bros. record assists me in fixing the date. That is the letter of transmittal of this report to Mr. McGraw, of the Gulf Oil Corporation in Tulsa. I can state independently of the report that the method of scale removal contemplated in 1928 involved the treatment of the well with inhibited hydrochloric acid. The report itself discusses the method I have just referred to. The scale that I wished to remove was deposited in both the tubing and the casing, inside and outside the tubing in the well.

Mr. Owen: You, personally, don't know these facts, do you, Doctor? A. That is right. However, the facts are definitely stated in company correspondence which is here for your examination.

Q. And the information you have regarding the subject you obtained either through reports or correspondence which came to your attention, or through verbal statements made to you by others? A. Not verbal statements.

Mr. Babcock: I think we had better go back a little bit, and I will ask the witness to give a little history as to how it happened he was working on this problem or the problems mentioned in this report. A. We were working on problems mentioned in the report because of the written request of Mr. McGraw, who is operating vice-president of the Gypsy Oil Company, a subsidiary of the Gulf Oil Corporation at Tulsa. Here is the original letter signed by Mr. McGraw and the letter by Mr. Dimit referred to there is right behind it (producing papers).

It is stipulated between counsel that wherever letters appear in the Williams Bros. record and are also produced here, we use the ones in the Williams Bros. record; that the letter from Henry McGraw to Dr. Foote appearing on pages 337 and 338 of the Williams Bros. record should be dated March 7, 1928, and that it may be used in lieu of the letter here produced by the witness; that the letter from Mr. Dimmit to Mr. Knappen of January 13, 1928, which the wit-

ness has produced, is the same as the printed letter appearing on pages 333 and 334 of the Williams Bros. record; that the letter beginning on page 337 of the Williams Bros. record was signed by Mr. Henry McGraw, and that the letter in the Williams Bros. record appearing on pages 333 and 334 was signed by Mr. C. P. Dimmit.

It was my understanding from the correspondence that this gyp was deposited in the wells and caused trouble in producing them and servicing the wells, and it was desired to find first some method of removal of the gyp and, secondly, possibly to find some method of preventing the deposit of the gyp. The immediate problem was obviously the removal of the gyp from the wells. Maybe it should be noted, by the way, that the term "gyp" is an oil field term which was used to describe deposits and it specifically relates to many chemical compounds. Like a lot of other oil field terms, it is something that was coined to describe that material.

In the report beginning at page 590 of the Williams Bros. record under "Conclusions," appears this statement:

"8. The release in pressure probably occurs at the surface of the sand in the well cavity, in which case it is reasonable to suppose deposition of more or less of the scale on the surface of the sand. Therefore, the trial should be well worth the expense for its possible value in increasing the production of the well entirely aside from the object of removing the scale from the pipe."

Mr. Babcock: First I will ask the question whether by that sentence you intended that the report convey the idea that you contemplated using inhibited acid to remove the deposition of scale from the surface of sand in an oil well? A. I did. The report states it very definitely.

Q. And did you have at that time anything in mind other than is conveyed by that statement in the report? A. No, I think the statement is quite clear that the treatment with hydrochloric acid was visualized as possibly doing something beyond the removal of the scale right in the tubing of the well itself. I don't believe there is any chance of

misinterpreting that recommendation and conclusion in the report. I contemplated and the report indicates that I contemplated using inhibited acid for this purpose. The use of an inhibitor was recommended in order to prevent damage to the steel equipment of the well from the acid, more accurately from attack by the acid.

The report indicates what particular inhibitor I contemplated using—that the inhibitor was Rodine No. 2. It is my opinion that the inhibited acid would react essentially the same as uninhibited acid on the calcium carbonate scale. Qualitative tests were made to determine this point. These tests were made during the course of the investigation which lead to this report. Qualitative tests were made and qualitatively there was no apparent effect between the action of inhibited and uninhibited acid on the calcium carbonate scale. Prior to making these qualitative tests, I did not have any knowledge on that point.

I had never had occasion previously to investigate the action of inhibited acid on calcium carbonate scales. In this one particular case, analyses showed that this so-called "gyp" scale was primarily calcium carbonate. The term is broad enough as used in the oil fields, however, to mean almost any kind of a scale.

My knowledge is from the official correspondence relative to recommendations made in the report, not from personal observation. These letters or reports were made to my superior, Dr. Foote, and he turned them over to me. According to official correspondence, the recommendations of the report were followed by the operating personnel of the Gypsy Oil Company at Glennpool. The correspondence shows that the first treatment was made on November 12, 1928, in the William Berryhill No. 8 at Glenpool.

Dr. Foote was senior industrial fellow on the production fellowship at Mellon Institute, and I was working with him at that time. In answering these questions, I am referring to the correspondence file I have before me of the Gulf Research and Development Company. This file is ordinarily kept at the research laboratories of the Gulf Re-

search & Development Company and I have access to their files. The letter of February 5, 1929, appearing on pages 368 and 369 of the Williams Bros. record, was signed by Henry McGraw and it quotes the report signed by F. W. Carl. In other words, the first portion of the letter is a quotation of a report in which the name "F. W. Carl" is typed in. The correct date of the letter is February 5, 1929. That letter was dictated apparently by Mr. Knappen. His initials "RSK" are at the foot of the letter. I recall I first saw this letter of February 5, 1929, within a very short time after its receipt at Mellon Institute. I definitely saw the letter before the end of February, 1929.

Mr. Babcock: It is stipulated that the letter the witness has just referred to is the same as that appearing on pages 368 and 369 of the Williams Bros. record with the corrections noted as to the date and signature.

As described in correspondence, other treatments were made in accordance with the recommendations of this report. I do not have those reports with me, however, but they can be made available. To the best of my recollection, there were other wells treated in the Glenpool, also in the Grand Bayou field in Louisiana, and I am certain that company files will contain copies of those reports.

Mr. Owen: The answer is objected to as secondary evidence. If reports are available, they should be produced.

Those reports are in our files at the Gulf Research and Development Company at Harmarville, Pennsylvania, and possibly also in the files of the Gulf Oil Corporation in Pittsburgh. Copies of those reports would be in the offices at Tulsa, at Houston, and at Shreveport, depending upon in what particular field the treatments were made. The Glenpool field is in Oklahoma, close to Tulsa, and the Grand Bayou is in Louisiana, close to the Red River, I believe. I have no personal knowledge of those treatments. I was not there when the treatments were made. I have been in both the Glenpool field and the Grand Bayou field. I am generally familiar with the methods of production of oil in those fields. The reports stated that inhibited hydrochloric

acid was used in these treatments and the reports are my only source of information.

Mr. Owen: The objection is repeated.

It is my understanding that Rodine No. 2 was used in the treatment of William Berryhill No. 8. If that particular inhibitor was used, it was used on the recommendation of my report. I have not an accurate enough recollection at this time to answer as to having had anything to do with the ordering of the inhibitor or anything of that sort—that is, the order for the manufacturer to ship and so on. The samples which I tested in the laboratory were not ordered formally. They were requested from a representative of the manufacturer and I have here a letter notifying me of shipment of those samples. These Rodines were made by the American Chemical Paint Company of Ambler, Pennsylvania.

Q. Did the reports of these field trials which came across your desk relative to these treatments recommended in your report show that it was possible to cause inhibited hydrochloric acid to react with calcium carbonate in the bottom of a well without seriously damaging the metal in the well?

Mr. Owen: The question is objected to as calling for secondary evidence. The reports will speak for themselves.

A. The reports indicated that the inhibited hydrochloric acid dissolved the "Gyp" in the tubing, and made no mention of any damage to the well equipment as a result of the attack of the acid.

Q. When these reports came across your desk, can you state whether you regarded the field trials as being a sufficient test to determine whether the procedure recommended in your report had been accomplished? A. It was my judgment from the reports that the treatments were in accordance with the predictions in the report.

I have read in the paragraph in Vol. 81 of the Federal Reporter, 2nd Series, beginning with the numeral 3, on page 498, starting "The patentee expended substantial sums—."

Mr. Babcock: In this paragraph which you have just read, I find this statement: "Yet its action for that purpose was exactly contrary to the prediction of the scientists, for it increased the deposit. If the outstanding scientists of the Mellon Research Laboratories forecast the exact opposite of the effect of this inhibited acid in the bottom of an oil well, it must be true that experimentation was necessary to prove that the idea of the inventor would work." Is the conclusion of the court that I have just read to you a correct one? A. The conclusion of the court is not correct.

Mr. Owen: I object to the question and answer as incompetent. The witness is not in a position to answer that question without knowing all the evidence that was before the court in the Williams Bros. case.

A. (Continued): I will qualify my answer in this way, that in my opinion the conclusion of the court is not correct.

Mr. Owen: I further call attention to the following sentence which precedes that which was quoted by counsel in his question: "When the research laboratory of the Mellon Institute, after elaborate experimentation, discovered that an inhibited acid would remove the limestone scale from the pumps and tubing, the scientists then suggested its use to prevent further deposits." I think the entire matter quoted in the question and that which I have just quoted should be considered by the witness before he answers the question.

Mr. Babcock: That is why I asked the witness to read that whole paragraph before I asked the question.

A. (Continued): In considering the previous sentence, I would like to point out that the quotation is in error in the first place in saying that the Mellon Institute suggested the use of inhibited hydrochloric acid to prevent deposition of the scale. That was never suggested.

Mr. Owen: Well, is that the reason that you suggested in your previous answer that the conclusion of the court was in error. A. No.

Mr. Babcock: I prefer that counsel not cross examine until I have finished my examination. I think that this is clearly a cross examination question. And with regard to counsel's objection, I wish to point out it is obvious the court, in making that conclusion, which I quoted in my question to the witness, was interpreting facts based on Dr. Westcott's report. Dr. Westcott did not testify in that case, but his report was before the court and I am calling this witness for an examination as to facts to determine whether the court correctly interpreted the report.

Mr. Owen: I again call attention to the fact that the only information this witness has according to his own statements is that obtained from the reports, some of which have been identified during his examination and others which were before the court in the Williams Bros. case have not been referred to.

Mr. Babcock: If counsel will point out those reports, I will determine on this examination if this witness is familiar with them.

Mr. Owen: Without undertaking to point out every report that was printed in the Williams Bros. record, I call attention to the report which is printed on pages 367 and 368 of the record dated February 1, 1929.

Mr. Babcock: In the statement of the court which I just quoted, it says: "If the outstanding scientists of the Mellon Research Laboratories forecasted the exact opposite of the effect of this inhibited acid in the bottom of an oil well, it must be true that experimentation was necessary—," etc. Now I ask the witness if he is able to find anything in any of these reports which shows that the results obtained were the exact opposite of the forecast made in his report. A. Nothing whatsoever.

Q. In your opinion as a scientist, would the pressure which might prevail in the bottom of a well have any material effect upon the action of the acid on the limestone or of the inhibitor in the acid? A. The pressure on the bottom of the well would have an influence on the rate of reaction of acid on limestone, which would be measurable in amount.

Q. Would it prevent the action of the acid on the limestone? A. If the pressure were high enough, it would greatly slow it down; and, theoretically, it could be high enough to stop the reaction, but that would be at a pressure which is very much higher than is usually encountered in an ordinary oil well.

Q. Would the effect of the pressure be any different whether raw acid or inhibited acid were used? A. I do not believe the presence of the inhibitor would have any influence on the effect of pressure. As far as the effect of pressure on the action between acid and steel is concerned, it is much less than in the case of the action of acid on limestone, and the pressure necessary to stop the action of acid on the steel is very much greater than would ever be encountered in any oil well. It is a matter of millions of pounds, which can be, of course, calculated theoretically.

Q. Referring again to paragraph 3 of page 498 of 81 Fed. 2d Series, is it true that in 1930 or thereabouts experimentation was essential to know the reaction of hydrochloric acid, inhibited or not, under pressure such as might prevail in the bottom of an oil well?

Mr. Owen: You are again asking for his opinion?

Mr. Babcock: Yes.

A. It is my opinion that such experimentation was not necessary.

Q. Is your answer the same, also, in regard to the presence of gases in the bottom of a well? A. I would like to have you state that question more definitely. Just what do you mean by that?

Q. Would experimentation be necessary in order to determine whether the presence of gases at the bottom of an oil well would prevent the reaction of hydrochloric acid on calcium carbonate? A. Only in so far as to determine the effect of pressure. If you are referring to the gases naturally produced by an oil well, the only effect would be in their contribution to the total pressure which was exerted on the system.

Q. In this same paragraph on page 498 of 81 Fed. 2d,

the court apparently quoted this sentence from your report: "The mechanism of the inhibited action is very little understood." Do you agree with that statement that the mechanism of the action of an inhibitor is very little understood? A. Yes, as to the actual mechanism of the chemical reaction, that was a true statement.

Mr. Babcock: The witness has pointed out that in the quotation it reads in his original report: "The mechanism of the inhibitive action is very little understood," rather than "inhibited action."

Q. Is the complete knowledge of the theory of inhibitors necessary for the proper application of inhibitors to industry? A. No. Such knowledge is not existent even today.

Q. When you made that statement in your report, did you mean to convey the idea that experiments would be necessary to determine whether an inhibitor would protect iron in an oil well? A. No.

Q. The same paragraph on page 498 of the Federal Reporter, Volume 81, 2d Series, further states:

> "When the Research Laboratory of the Mellon Institute, after elaborate experimentation, discovered that an inhibited acid would remove the limestone scale from pumps and tubing, the scientists then suggested its use to prevent further deposits."

Will you please comment on that statement? First state whether you did conduct elaborate experimentation to discover that inhibited acid would remove limestone scale. A. The experiments could hardly be called elaborate. They were comparatively simple. They consisted in establishing the fact that the scale was principally calcium carbonate by analyses; that it was readily soluble in hydrochloric acid, inhibited; and that inhibited hydrochloric acid had very little damaging effect on steel tubing. Prior to these experiments, in so far as I was familiar with the use of inhibitors for this purpose, and since steel tubing is ordinarily a plain carbon steel, I knew that inhibitors would be effective when used in this manner. What I am referring to

is the fact that steel tubing is ordinary steel, and that inhibitors had been in common use in steel mill practice to prevent the attack of acid on the steel. I did know that the use of an inhibitor would protect the steel tubing from the action of the acid. The tests which were made were purely confirmatory of that knowledge. After finding out that the scale was soluble in hydrochloric acid, I did not then suggest the use of hydrochloric acid to prevent further deposits of scale in an oil well.

Mr. Babcock: I notice on page 404 of the Williams Bros. record a certain conclusion in a letter dated July 21, 1931, from L. C. Case to W. B. Wilson with reference to acid treatment in a well known as Gypsy No. 3 J. Anderson. Will you first state who L. C. Case is, if you know? A. Mr. Case was the chemist employed in the geology department of the Gypsy Oil Company in Tulsa.

Q. Is he still employed there—do you know? A. He is.

Q. Who is W. B. Wilson? A. W. B. Wilson was chief geologist of the Gypsy Oil Company at Tulsa.

Q. The conclusion I have reference to is the first one under "Conclusions" on page 404 of the Williams Bros. record, and it seems to indicate that some condition on this well seemed to Mr. Case to be the reverse of the desired result and the reverse of what would happen if the acid were added directly to the water. I would like to have you explain, if you can, these conclusions and state first whether these experiments on the J. Anderson No. 3 had anything to do with the recommendations of your report of July, 1928.

Mr. Owen: May I suggest that the Conclusions referred to be read into the record?

The Witness (reading): "Conclusions. When this treatment was suggested, no trouble was anticipated in getting the acid to the bottom of the well. It has been shown that the acid is being neutralized by scale on the casing, so that, after reaching the bottom, the solution increases the scale-forming compounds in the water. This condition is the reverse of the desired result and the reverse

of what would happen if the acid were added directly to the water."

A. No, they had nothing to do with the recommendations in my report. The difference between the experiment carried on this J. Anderson No. 3 and the treatment recommended in my report was that the treatment recommended in my report was intended to remove scale already deposited in the well, whereas the treatment described in Mr. Case's report involved an attempt to prevent accumulation of scale in the well by continuous treatment of the well with hydrochloric acid. That treatment on J. Anderson No. 3 was an entirely different experiment than I had previously recommended in my report of 1928. I had nothing whatsoever to do with the treatment on that J. Anderson No. 3.

Mr. Case was not connected in any way with the Mellon Institute. This report of mine was made by the Mellon Institute to the Gypsy Oil Company. The relationship, if any, between the Mellon Institute, the Gulf Oil Company and the Gypsy Oil Company is that The Production Fellowship of Mellon Institute was supported by the Gulf Production Company, at that time a subsidiary of the Gulf Oil Corporation. The Gypsy Oil Company was also a subsidiary of the Gulf Oil Corporation.

Q. I have noticed in reading that decision of the Tenth Circuit Court of Appeals in the Williams Bros. case that it is stated a time or two that sand or sandstone was impervious to acid. Will you please state whether sand or sandstone is impervious to acid? A. It is difficult to answer whether sand or sandstone is impervious to hydrochloric acid because of the loose use of the term "impervious." Many sandstones contain various amounts of material that are soluble in hydrochloric acid, and I assume that this is the sense in which "impervious" was used in the question. I make a distinction between the words "impervious" and "soluble." As used in this connection, "impervious" means to me that the acid does not attack sandstone. Hydrochloric acid does attack some sandstones, the amount, as explained above, being dependent upon the composition of each particular sandstone.

The records will show that the Chemical Process Company has been engaged to treat wells of the Gulf Oil Corporation. The records will be available in the district office at Tulsa. Such records are not kept at the Pittsburgh office. From my knowledge of the art of treating oil wells, it is my opinion that inhibited acid is not necessary for successful treatment of limestone in wells. I do not believe the outcome of the treatment as regards an increase in oil production would be dependent upon whether an inhibitor was used in the hydrochloric acid or not.

CROSS EXAMINATION

I received no additional instructions from those given in the letter from Mr. C. P. Dimit to Mr. Henry McGraw, dated February 23, 1928, and the letter from Mr. McGraw to Dr. Foote, dated March 7, 1928, stating the problem which was submitted to me, in connection with which I made the report which is reproduced in the record in the case of The Dow Chemical Company vs. Williams Bros. Well Treating Corporation at pages 587 to 599, inclusive. I did request some further information on the producing conditions at Glen Pool, the request being made in writing. A memorandum dated May 24, 1928, which appears at pages 340 to 341 of the Williams Bros. record, at the bottom of which appears the signature "B. B. Wescott," is the one to which I refer. In response to that inquiry, I received the information contained in this letter of September 27, 1928, signed by Mr. McGraw and written to Dr. Foote. The date my report was transmitted was July 19, 1928. Information to which I have just referred did not reach me until after the report was made. It makes very specific mention of that in the letter. A copy of the letter of September 27, 1928, to which I have just referred, is printed on pages 362 to 364, inclusive, of the Williams Bros. record. That letter was signed by Mr. Henry McGraw and dictated by Dr. Knappen.

Before I made my report, I did not receive any information regarding the problem other than that contained in the Dimit and McGraw letters which are copied on pages

333, 334, 337 and 338 of the Williams Bros. record, except some information relative to the actual receipt of the samples in Pittsburgh. Those were samples of tubing and of water from Glen Pool, according to the correspondence. The illustrations on page 589 of the Williams Bros. record represent the samples of tubing which I received. Those were portions of the samples I received. I don't recall how many samples altogether I received. Page 588 of the Williams Bros. record indicates the samples I received. One of those samples numbered 425 was a sample of the scale from the outside of the 19th joint of tubing, according to that statement. That sample was, roughly, probably about 3 feet long, but I don't recall accurately. It was not separated from the tubing itself, the tubing was there. It was a sample of tubing on which the scale was deposited both outside and inside.

The description on page 588 of the Williams Bros. record was what the figure was intended to illustrate. If you will note, the figure and title says the scale was chipped off at the top to show the thickness of the deposit, and these representations on page 589 are of portions of sample 425. Those sample numbers, No. 425 and No. 426, were numbers given to our laboratory samples, which were taken from these tubing joints submitted to us. Sample No. 425 refers to the scale which was taken off from the outside of the tubing in table 3; sample No. 426 refers to scale which was taken from the inside of the tubing as described in table 3. Those two tables are reproduced on pages 590 and 591 of the Williams Bros. record. The tubing itself was not given a sample number. According to the description of these samples, they came from "Jennie Spocogee Well No. 5:" That was not the well in which my suggestions were tried out, which my testimony this morning showed to be William Berryhill No. 8. It is true as far as the first treatment is concerned, none of the samples of water No. 427-430, inclusive, on page 588 of the Williams Bros. record, came from the well in which my recommendations were tried; as for the subsequent treatments, I would have to look up the records. I don't know if subsequent treat-

ments were made in any of these particular wells or not. It is true as far as treatment in Berryhill No. 8 is concerned.

When I went to work on that problem, my first experience with oil well production problems dated from the inception of the production fellowship in Mellon Institute. That was, I believe, in May, 1927, or June, 1927, which was the date when I went to work for the Mellon Institute on this fellowship. For about a month, I was the only one on that fellowship, I think. Subsequent to that time, Dr. Foote and one other man came, and shortly there were several others. It increased very rapidly from that time on. Dr. Foote was the senior fellow. The Gulf Oil Company or its subsidiaries had two other fellowships at the Mellon Institute when I went to work on this fellowship. One was known as the Gulf Refining Company fellowship, and the other, I believe, was described as the Production Corrosion fellowship. I don't know accurately how many fellows were employed in each of those fellowships when I first became acquainted with them. The Gulf Refining fellowship probably had in excess of ten men. That, however, can be verified from the Mellon Institute records very easily. The Production Corrosion fellowship, I believe had two men. I do not know definitely how long those two fellowships had been established prior to the time when my particular fellowship was established—The Gulf Oil Refining fellowship, for a period in excess of five years, and the Gulf Production-Corrosion fellowship, probably about three years.

The fellows working under those other fellowships were graduate scientists. I wouldn't say as to all of them on the Gulf Refining fellowship, because in common with other fellowships, they had fellowship assistants. Both of the men on the Production-Corrosion fellowship were graduate scientists. Some of them had Doctors degrees in the Gulf Refining fellowship, not in the Production-Corrosion fellowship. They both had Bachelor of Science degrees. These reports that were made by the fellowships, and particularly by my fellowship, were submitted to the donor of

the fellowship. They are not usually published in any printed publication unless by the consent of the donor, I assume. To my knowledge my report was never published in a printed publication aside from its appearance in the printed record of the Williams Bros. case.

Prior to my employment on this fellowship, I had some experience in the steel industry in the chemical laboratories, where I became acquainted with the use of inhibitors. My work in the steel industry had particularly to do with the use of inhibitors in the steel industry. In that connection, I had the work of investigation of inhibitors for pickling work. "Pickling" is a term applied to the removal of scale from hot steel products. That scale would be usually iron oxide. It was never anything else to my knowledge. It is principally iron oxide, there may be slight amounts of silicates in some cases and not always iron oxide. There may be manganese, silicates, silicon oxide.

The principal cause of the formation of scale on iron work which is pickled is from the heating of the iron and processing it. It is not an unavoidable result of heating. It is a common result. There are several purposes for removing that scale in the pickling operation. In almost every case, it is to expose a clean metal surface. It may be done for cold rolling operations afterwards. It may be done as the preliminary to hot galvanizing. Any kind of electro-plating. The further treatment, such as galvanizing or cold-rolling or electro-plating, may or may not generally follow shortly after the pickling operation. Other scale or rust does not very often form on the pickled metals and require their further pickling treatment. It may eventually form if it is stored long enough under unfavorable conditions as regards moisture and air.

I learned of the Rodine inhibitors in connection with my pickling work in the steel industry. They were quite generally used in that field by a number of different companies. My first work on oil production problems occurred after I became a fellow for the Gulf Production Corporation. Prior to my work as a fellow, which resulted in the report which is printed in the Williams Bros. record begin-

ning on page 587, the work I did on production problems was on corrosion of production equipment, mainly for the short period prior to the start of the investigation on "gyp" formation.

The Production Corrosion fellowship was concerned with corrosion of production equipment merely for the Gulf Production Company of Texas and the Gulf Pipe Line Company of Texas, whereas the Production fellowship at Mellon Institute was concerned with production problems of the whole Gulf Oil Corporation and all of its subsidiaries. Production Corrosion fellowship was definitely for the Gulf Production Company and Gulf Pipe Line Company, of Texas, Louisiana and Arkansas.

At the time I was working on this "gyp" problem and for several years prior thereto, the Gulf Companies owned production in lime fields, where the oil is produced from lime formations. Those fields were in Kansas, Oklahoma, Texas, specifically the Eldorado field in Kansas, the McElroy field in Texas, the several fields in the Panhandle district of Texas. The Gulf Companies have substantial production in those fields.

Prior to the time when I made my report on this "gyp" problem I had not had any actual field experience in connection with oil production. My work had been confined to laboratory work and field trips for observation. My first field trip was in the summer of 1927 to various fields all over Texas. The trip was a general trip intended to acquaint me with general methods and problems of oil well production. I think that is the best way to put it.

Q. In your direct testimony I understood you to say that in your opinion the use of inhibitors in hydrochloric acid would not affect the action of the acid on the scale. I will ask you what, if any, tests you made to determine that fact. A. Qualitative tests were made. These tests consisted in treating the scale with inhibited hydrochloric acid. When the tests were made on the scale, it had been removed from the pipe. I don't recall definitely whether I ever tested the effect of inhibited hydrochloric acid on oil well pipe from which the scale had not been removed

at the time of that investigation or not. They were done subsequently, however. I don't recall having made any at the time of my report, but I did make such tests subsequent to the date of the report.

With regard to my qualitative tests with inhibited acid on scale, it consisted merely of treating the scale with inhibited hydrochloric acid to determine qualitatively whether there was any appreciable difference in the amount of the scale dissolved or the rate of dissolution. As I recall, the test was probably placing the scale in the acid. I do not recall definitely having done anything else in that connection. I wouldn't say that I did not, though. That test was made on the sample of scale received in connection with the submission of the problem. That is the only sample of scale I had. I would have to look at the records as to having ever tested any scale that came from other wells or other locations, but I believe that some samples were submitted from Grand Bayou field.

There are a great many different chemical combinations in the scale in different locations, also in samples of scale deposited in engine jackets from water, depending upon the constituents of the water or the impurities in the water. If I received any scale from different locations, I undoubtedly tested them, when submitted to me, for a period of approximately two years from 1927. Any samples of the scale that were submitted to me during that period were tested. As I say again, I don't recall definitely whether we had other samples or not. The only tests that it would have been necessary to make were to determine the composition of the scale. I will have to consult the record to tell definitely whether I did any work along that line. My recollection isn't clear in regard to other samples from Glenpool or Grand Bayou.

Q. I believe you expressed the opinion that pressure would have no effect on the action of the inhibitor in hydrochloric acid, or did I misunderstand you? A. With regard to the action of acid on what?

Q. On lime formation. A. I believe the statement I

made was that it would not have a very appreciable effect as distinguished from absolutely no effect.

Q. And that opinion is expressed on the basis of your knowledge at the present time, I assume. A. Also my knowledge at that time.

Q. In other words, you say that would have been your opinion then? A. That is right. That answer applies only to the effect of the inhibitor itself, not to the effect of pressure on the action between hydrochloric acid and scale.

Q. And what effect would the pressure have on the action of the acid. A. It would slow it down. What I understand you are trying to distinguish between is the effect of inhibited and uninhibited acid as regards pressure.

I know who Mr. F. W. Karl is. At that time he was a corrosion engineer for the Gypsy Oil Company, and had been with them for a very short period. He was not one of the members of the corrosion fellowship. He was one of the field engineers. I knew him personally. I would say that he was very competent in his line of work and was when I first met him, I believe in about 1926.

I first met Mr. Henry McGraw either late in 1927 or early in 1928. At that time, he was vice-president of the Gypsy Oil Company. He was not a scientific man. He was a lawyer engaged in the oil production business. When I first met him, I considered him to be fairly competent as an executive. I discussed technical problems with him only in a very general way, not in any detail at all. I believe, considering the fact that he was a lawyer, he had an excellent grasp of the technical problems involved in the production of oil.

Mr. Leovy was vice-president of the Gulf Production Company located in Pittsburgh. Mr. R. L. Wright at that time was chief production engineer for the Gypsy Oil Company. He is a technically educated man. As far as I know he was a graduate engineer.

Mr. C. P. Dimit was superintendent of production for the Gypsy Oil Company. I am not sure at that time what Mr. M. E. Chapman's connection was with the Gulf Company. He was at one time an assistant to Dr. Knappen,

and later he was production engineer for the Gypsy Oil Compay. He was technically educated; I am not sure what his degree was, but I think it was in geology. That is merely my recollection of it. Mr. W. B. Wilson was chief geologist for the Gypsy Oil Company. He was technically educated. His degree was in geology. I know Mr. L. C. Case. I knew him in 1929. He was a chemist in the geological department of the Gypsy Oil Company. I do not have in my correspondence file a copy of a letter written by Mr. Case to Mr. Wilson on August 30, 1929. I know Mr. D. L. Traps. His title at the time of his connection with the Gulf Company was consulting engineer. He was technically educated in engineering. Frank J. Reed was a chemist employed in my division. Mr. S. G. Sanderson was at that time production superintendent for the Gypsy Oil Company. He would replace Mr Dimit. He was not a technically educated man. Mr. W. L. Rushmore was the production engineer for the Gypsy Oil Company. Mr. H. H. Power was, I believe, at that time chief engineer for the Gypsy Oil Company. He may, however, have been consulting engineer at that time, I am not quite sure. He was technically educated. I believe Mr. Rushmore was technically educated, I am not certain about him.

I have seen several acid treatments made on wells of the Gulf Company, or its subsidiaries, by Dowell Inc. and by Halliburton Oil Well Cementing Company, for the purpose of increasing the production of the wells, but again it would be necessary for me to consult my records to make absolutely certain who made those treatments. I believe those treatments were made about 1931 and 1932.

I did not receive any samples of the producing formation in the Glen Pool during the time I was experimenting on the gyp problem and prior to the time when I made my report of July, 1928. I don't recall whether or not I knew at that time what the producing formation was in the Glen Pool, the geological name of it. I believe the producing formation in the Glen Pool is reactive to hydrochloric acid, but to what extent, I couldn't say. I have no direct knowledge on that subject. I made no tests on it.

REBUTTAL PROOFS

DR. CARL F. PRUTTON,

a witness called by plaintiff, was recalled, and testified further as follows:

DIRECT EXAMINATION

By Mr. Owen:

Q. Doctor, you heard the testimony given in this case regarding corrosion tests made by Dr. Bartell and by Mr. Douty and Mr. Hathorn. Will you consider and compare the results of those tests insofar as they are comparative, and in doing so, confine yourself to the tests with the Hathorn soft metal tanks. That is, I want you to consider those tests with reference to the effect on corrosiveness of hydrochloric acid on steel of the presence of small quantities of lead chloride, copper chloride and iron chloride in the acid. A. There have been described by Mr. Douty, Mr. Hathorn and Dr. Bartell and myself, a number of different types of tests for determining the corrosiveness of acid and the effect of dissolved metal chlorides, particularly the lead chloride and copper chloride upon that corrosiveness. There have also been tests described to show the effect of the lead plate in protecting the storage tank or truck tank in the so-called Menaul process. The one thing that can be gathered from all of these tests, although the tests all varied in metals used, in specimens, in the detailed method of cleaning, throughout all of them the results of tests made in which acid containing approximately 4 parts per million of copper and around 400 parts per million of lead, both in the form of chlorides, and about 400 parts per million of iron, the results are remarkably close from a comparative standpoint. The results that were reported by Dr. Bartell showed that those concentrations of metals which he had found in his analysis in the Halliburton truck samples gave

approximately 40% inhibition on one of his test methods, or 40% reduction in corrosiveness. Then he varied his test conditions to come closer to some of the conditions that we had used in our laboratory test and he got results up to around 60 to 65%—in that range.

Q. That was by agitation? A. By agitation and by using a little greater volume ratio to the area of the sample. Then the tests that were reported by Mr. Douty in his laboratory tests that he ran personally himself, indicated that the copper, iron and lead chlorides corresponding close to the compositions that the other men had tested, showed 50 to 60% inhibition, or reduction in corrosiveness. The single test that Mr. Hathorn reported in his large tank in which he used a type of steel that is comparative to the tubing and casing, the tank was made from a piece of casing, as shown in his last curve, showed 40 to 60% inhibition due to the dissolved metallic chlorides. His results on the hard steel tank were not conclusive but the ones on the soft steel tank show 40 to 60% inhibition. The results that I reported from our special condition laboratory tests, using a small section of well tubing, showed about 65% inhibition in the laboratory tests. And therefore, the figures that were reported by various men Dr. Bartell has covered a range of 40 to 65% approximately, Mr. Douty from 50 to 60%, the tests that I reported in the laboratory test alone, showed about 65% and the tests that Mr. Hathorn reported on this soft steel tank with the added metal chlorides present showed 40 to 60%. And I think that is quite a remarkable agreement in measuring the reduction in corrosiveness of acid under these widely different sets of conditions.

So that is the thing that can be compared out of all of these tests, is the effect of these added metallic chlorides, and the fact that the range covers a range of twenty-five per cent is not unexpected at all.

Q. Will you make a similar comparison with reference to the effect of the presence of lead chloride alone, in fifteen per cent hydrochloric acid? A. Well, the effect of lead chloride alone is not so clear cut in the various tests. I

reported several tests in which the inhibition ran somewhat over ten per cent in my laboratory test alone. Dr. Bartell reported approximately ten to fifteen per cent. The figures that Mr. Hathorn reported are confusing and the only one that could be used to show that is one curve which showed a considerable inhibition due to lead chloride. I believe if I could refer to the curve, why, you could see it.

But there is—I hesitate to draw too many conclusions from these curves. I think that from these curves you could draw any conclusion you wanted to, and the C. P. acid is up here, and the C. P. acid plus lead chloride alone is down here, and there is considerable reduction if you take the vertical distance between these curves, there is approximately fifty per cent, without calculating it closely.

I have indicated in my direct testimony that I believe the check determinations are within about ten per cent, and the different observers using different tests, of course, you could get further variations.

But there is a considerable variation between the C. P. acid and the C. P. acid plus lead. Then when he (Hathorn) added copper again, however, he spoiled the picture by showing it had no effect whatever, which is contrary to all four men's laboratory results. So the picture is not so clear.

Now, Mr. Douty ran lead chloride in laboratory tests, and in a fifteen hour test he showed 39 per cent reduction in corrosiveness due to the lead chloride, and in a 96 hour test he showed 38 per cent reduction in corrosiveness, so his figures are the highest of the group and would come closer to the figures indicated on Hathorn chart, Sheet No. 6, but I say I hesitate to draw any definite conclusions from these curves.

Q. Have there been any tests described during this trial other than your own that would give any measure of the effect of the Menaul electrical hook-up to the oil well tubing or casing? A. The only tests that have given any indication as to how the actual Menaul system would perform on the oil well tubing have been tests that I reported.

The other tests have confined themselves to large areas of lead in close proximity to steel surfaces and both surfaces covered by acid. And, therefore, I do not believe that the other men that reported tests can draw any conclusions from those tests as to what happens down in an oil well tubing system remote from the Halliburton or Menaul type truck tank.

Q. You heard Mr. Hathorn's description of the method used in cleaning the tanks between tests. I would like to have your comment on the effectiveness of that method of cleaning and its possible effect on the results of the succeeding tests? A. I hesitate considerably in discussing other people's work, and for that reason I have hesitated to draw too rigid conclusions from those curves. That is particularly true in the testing of corrosiveness of solutions. I have been engaged in testing the corrosiveness of various materials for fifteen or twenty years, and have supervised hundreds and thousands of tests, without doubt, in various types of products, and know the variability that can be expected, and the variability due to the surface condition of the metals and the formation of various types of films on the surface which affect results.

The running of inhibition tests by inexperienced people, or people who have not had experience in running those tests, is a very dangerous thing, and can lead to erroneous results. Not knowing exactly what experience Mr. Hathorn and his co-workers have had in running inhibition tests, I hesitate to draw any rigid conclusions as to the results; but the tremendous variation of these curves from which you can draw any conclusions whatsoever—any conclusion to be desired could be drawn from those curves—indicates to me that the work evidently was not controlled very accurately.

One of the things that to me—not knowing the details of the cleaning operation, but the immersion of a lead-coated steel tank into a sulphuric acid solution to clean off the surface, when it is known that lead is used for the handling of sulphuric acid because it will not dissolve, even

carrying the work—in electrochemical work, lead is used as an insoluble anode in sulphuric acid solutions—then in addition to that, to using a bath that is used for pickling commercial work, in which steel evidently with the oils and greases and dirt that get on to such steel objects, in the working and shaping of the steel, and many of those oils that are used in the work—many of those oils containing a considerable amount of sulphur, containing organic compounds which are well known inhibitors, and the fact that the condition of that tank was not known accurately, whether there were any dissolved metallic materials in the tank—all this would indicate to me that the cleaning might have been quite a major factor in determining the variability in the results.

Those are about the only comments that I could make upon the possible deviation and inaccuracies that have occurred.

The Court: Well, we have inaccuracies in all our experiments. How can I know that anybody got their container clean? A. We studied in this method that we employed for cleaning our surfaces, we took small pieces of the steel tubing and used this cleaning operation method and could take those samples after doing that, and get reproducible rates of solution and acid before and after solution containing lead and various other material. When we come back to the commercial acid we get the same result. The checking of the method of cleaning that we employed in our tests, Mr. Douty, Dr. Bartell, Mr. Douty and I in particular, were very similar in that we pickled all the samples in hydrochloric acid and then brushed off the material on the surface to remove any surface deposits to get down to fairly clean metal, and then started in. Now, the use of the anodic cleaning in sulfuric acid introduces a variable. I wouldn't want to say what effect that had even though the tank were free from impurities, no grease on the tank, no metals in the tank system proper.

We took the same piece of tubing, determined the rate of corrosion, took that tubing, cleaned it, got exactly the

same rate; then took the tubing, ran it in lead and copper chloride solutions, cleaned it again, put it in commercial acid, and got the same rate as before.

The Court: The second run? A. Yes. We gave it a cleaning after the lead treatment; after the lead chloride, copper chloride, we gave it our cleaning.

The Court: Then what did you do? A. Put it in commercial acid and got the same result as we had gotten in commercial acid before. That would indicate. I say the same—I don't mean exactly the same—I mean within the limits I have indicated corrosion tests should be run if you specify every single factor and carefully control. That is approximately 10%. I think I have stated that before. It is within about 10% of corrosiveness.

The Court: In what way does this dissolve or in what way does this metallic chloride, whether copper, lead or iron chloride that is in the acid protect the iron? What was the method for doing that? A. The only way I can see, and I have no experimental evidence that will back it up. Mr. Douty has shown when you connect a lead plate with a piece of steel you actually get some lead plated on there and a reduction in corrosion against that steel which is perfectly in agreement with my views. I wouldn't criticize that part of it. But when you only have lead chloride in solution then it is my belief that you get a very spotty coating of molecules or particles of lead not as complete as Douty reported on his case where the lead sheet was actually connected with the lead, but you get a very spotty coating, and that incomplete coating of lead and of copper, it is well known, for example, that when you put a piece of steel in your copper sulfate or copper salt solution, you get copper coating, red color copper. I believe that takes place to a small degree.

The Court: That is with the degree you get protection on it? A. Yes. Now, in the electrolytic method when the electrodes are close together, they get a fairly continuous sheet of lead.

The Court: In other words, whether it be with the

electrical connection that goes right across, deposits down, or whether it be in solution, or goes slowly across, all the protection the iron ever gets is by coating? A Is by the coating, and the effect that that coating has upon the actual corrosion mechanism. That coating itself is not a protection in itself, but in the corrosion of iron and steel hydrogen tends to be formed on the surface of the metal. We see that when we put a piece of iron into hydrochloric acid, and see the bubbles of hydrogen evolved. Those individual bubbles tend to hold that hydrogen on the surface and in that way insulate the surface from the acid and prevent the electro-chemical solution of the iron. In the case of a continuous lead coat, that is like putting a coat of paint or a sheet of rubber between the two. It protects, of course, by that method, but it is not a complete coating of copper or lead. I wouldn't believe that that would be possible. If it were, you could see a red color or color of copper when you use these very dilute copper solutions.

Mr. Owen: I show you Mr. Douty's notes, DX-299, and call your attention to sketches on the back of sheet B which I understand to represent the set-up for Mr. Douty's tests. I believe you are familiar with these notes, and I will ask you to examine those sketches and point out the course of the current in those.

The Court: Before you take that step up, how about the experiments performed in these tanks by the young man from whom these charts were drawn that are now on the trestle-board being more similar to the actual use of the storage tanks and the transportation tanks—or the transportation tanks, than any of the others? If I could only test those, that would be more similar than any of the other tests. A. In the truck tank, the Menaul truck tank?

The Court: Yes. More like the Menaul truck tank work than these others, or wouldn't it? I don't know. A. Well, the feeling that I have had and that I have expressed, I believe, in my testimony, is that in the work that we did we were not primarily interested in what protection the lead sheet gave that truck tank; that we were interested in

the part of the Menaul process which involves the protection of the well tubing and, therefore, we used that tubing method. Now, the question as to how much protection the lead sheet gave our tank and whether our tank was more comparable to the Halliburton tank than the ones that are shown here, is also a question that is in considerable question. The tanks shown here do not have the lead plate welded on the bottom.

The Court: I follow you.

The Witness (continuing): The question was with relation to Mr. Douty's tests in which he used the lead sheet touching the steel strip in his corrosion experiments. Of course, the arrangement of the lead sheet and the steel could hardly duplicate the conditions you have in a truck tank, and the ratio of the lead area to the steel area is considerably at variance with the actual ratio which Mr. Hathorn used and which we used, and the lead strip was scraped clean with steel wool, which is not done, as I understand it, in service, and which we did not do, and I do not believe the lead sheets in those tanks were scraped with steel wool, which would roughen the surface greatly. And then the lead sheet was bent around and made to contact in two separate places with the piece of steel.

I think that in this test that he describes that all precautions were taken to get that double contact with the lead sheet as shown in his picture on the back of page B where the steel strip is contacted both at the top and at the bottom of the lead sheet. The arrangement of the lead sheet in the beaker test that he ran was as shown in the middle figure on the top part of the back of page B, and shows his beaker in that position (indicating on blackboard) the lead sheet bent into a sort of a "U" and then around in this fashion (indicating), and then his steel strip in contact here and at the bottom with the steel contacting the lead in two places.

Now, that would insure that the distance from lead to steel was fairly close and in the truck tank there are portions of steel that are fairly well removed from the—that

is, as I understand, the bottom of the truck tank has a sheet of lead on it, and the sides of it extend up some considerable distance and the lead is fastened here, but the steel is not brought in quite such good contact.

The Court: I understand there is acid under the lead plate—isn't there? A. There is acid under and over, covering up to some considerable height, and in the tests here, the acid was over the top of the system.

I do not want to point out any great difference here, because I do not think for the purposes that we are discussing it here, the significance is great, but there were some slight differences between the tests and what actually occurred in the tank.

Q. I would like to have you comment further on the Hathorn tests and curves. A. The curves that have been obtained, if we take some of these curves, we find a looping up in this direction, and unless you knew that there was a discontinuity here (indicating), normally you would plot that, just drawing a line through this (indicating), sort of in that direction, and knowing the tremendous variations that occurred between individual tests, you would not try to draw any conclusions from the change in slope of that line, and particularly the change in slope of this line, compared with this other line, which shows such wide variation.

Now, you may say, well, they took samples immediately after disconnecting the lead, and it showed an increase in iron content, indicating that where the lead plate was disconnected, there are some points in here that show, when they took samples immediately thereafter, and that is perfectly true, that there was an increase in the rate of attack when that lead plate was disconnected.

I have indicated, and I think these tests indicate, that the lead plate does something in inhibiting by electrical means, the attack of the acid upon this, upon these particular hard steel tanks, and that this slope here is much less than the slope here (indicating).

But, if you take this slope here, when this was disconnected (indicating), the slope is just as flat as this lowest

one, with commercial acid. So if you take the average here, it would show that there is still inhibition in the acid (indicating)—

The Court: But the lead plate— A. (Interrupting): The lead plate does some good.

The Court: Was bringing about some action? A. Some action, but there is a continuing action, and it is difficult to say just how much, but this shows inhibition (indicating). We don't know whether this solution at this time was the composition of their truck samples that we obtained from the field, with the high copper content; possibly it wasn't although you can't tell, you can't tell a thing unless you knew the concentration of the metals in that solution, and if they carried on what actually occurred in the Halliburton truck tanks.

I am explaining on sheet 1 the results on the hard steel tank, which is steel supposedly used in the truck tanks. That follows through, I believe, on all the steel tanks. You get that flatter part there (indicating) but when you get over to the results on the soft steel tank, made from a piece of well casing similar to a well tubing, the picture changes completely. I want to show you those figures and curves. On sheet 4 the effect of the electrical protection is substantially zero. There may be some slight change in slope in the upper part of the curves, there may be some break here (indicating top of sheet) I can't detect it. Here is commercial acid, Tergitol, lead plate, test 4 (indicating); commercial acid and lead plate test 5 (indicating); commercial acid plus lead plate test 3 (indicating). All show no sudden jump here in iron concentration. But when you come down here to this one test (indicating) there are three tests with the lead plate that show no electrical effect.

The Court: This lead plate was connected? A. Up to this point (indicating) and then disconnected.

Mr. Owen: Where the dotted line starts.

The Court: Now, what is your explanation for that? A. My explanation is that this protection—this is a little

lower than the commercial acid—is substantially not due to electrical protection but due to the lead and copper dissolved in the lead plate. If there were electrical protection and a sudden jump here, great change in slope. You see he has tests 4 and 5, commercial acid and Tergitol, lead plate—

Mr. Owen: The three with lead plate are numbered 3, 4 and 5. 1, 2 and 3 on sheet 4. A. The one that shows electrical protection is curve for test 6, 3 tests showing electrical protection, and one showing not.

Mr. Owen: Test 6 contains Tergitol. A. That is on sheet 4, the soft steel tank. We go over to the next curve on soft steel tank. These are curves where we measured this change in slope. Now, there are many changes in slope on these curves, but if there is any electrical protection—you will recall we put a straight edge on this—there is a slight change in slope there. If there is any electrical protection it is a very minute amount. It doesn't show this coming across horizontally and branching out. The amount is very minute. That is true in tests 5, 6 and 7—3 tests with the lead plate. Now, they have still another lead plate, to make this picture complete, No. 3, which shows no inhibition and shows practically the same as commercial acid but they did not disconnect the lead sheet from the tank in the test and we cannot tell what happened, up there. Now, here we have on a soft steel tank, 7 tests, and 6 of those you can see that the lead plate has practically no electrical inhibiting effect; one of them shows it has a very strong electrical inhibiting effect. And that argument is used to prove you cannot find out anything by a test. My conclusion is that the one test is wrong, the one that showed the marked variation resulting from the electrical connection.

The Court: Now, I am at a loss again. I thought you were talking just on the soft steel. A. Yes, sir, on the hard I frankly admit there is a distinct electrical protection.

The Court: Can you tell me why there would be on

hard steel and not on soft steel? A. No, I cannot. Some of these corrosion inhibition effects are things that are difficult to explain.

Mr. Owen: Well, Doctor, has anything been presented here by Mr. Douty or Mr. Hathorn that in any way changes the views you expressed in your direct examination? A. No, sir.

The Court: In all these tests, Doctor, I get it that you do think that all that has been found in the Halliburton tanks can in fairness, honesty and scientifically be explained as being made by the lead connected up with the iron? A. I think that it is quite reasonable to explain the protection of the tank by that lead plate. And I would admit any amount of protection ranging from zero up to close to 100% as being possible.

The Court: And you don't think that without reference to oral testimony at all that you had reached the conclusion there had been something else independently added in addition to what, from the lead connected with the iron? A. I just can't tell.

The Court: All right.

(Witness continuing): Because the amounts Dr. Bartell found in these field samples on the few tests that we ran in our tank, or simulated Menaul tank, we didn't get the high copper content, got a greater iron content, didn't have the same ratio of metals but the inhibition was about the same with a degree of the reduction of corrosiveness as was found in the samples duplicating Dr. Bartell's analysis of the field truck samples. But I can't explain exactly, and I don't believe just, without a great deal of evidence, that something has been deliberately dumped into the tank.

The Court: Out of all of them, the variations so wide, have you reached any conclusions as to what percentage of the protection comes from this direct protection while it is connected and from the chlorides that have been created and are still in the liquid? A. I don't believe that I can or any of the figures here could tell exactly what percentage that would be. As to the per cent in the truck tank.

as to what percentage is electrolytic protection and as to what percentage is chemical, I don't believe you can tell.

The Court: They start out from the lead, evidently, don't they? A. They start out from the lead.

The Court: Is there any difference between them when they leave the lead chemically or any other way? Is there anybody living that knows any difference between those that go across and form a plating and those that become tramps floating around there, like a bunch of hoboes? A. They are all the same.

The Court: They are just the same, and it is just mere accident which gets over there by coating and which are floating around. A. Just some of them get over there, and it is haphazard.

The Court: And when we stop and make our test we have just caught some of them on the way, as you might say? A. It is more than that.

The Court: If they kept on up to the top some of them would have got over, wouldn't they? A. It is not quite like running from a piece of lead over here to a piece of iron; the amount that actually goes over there and continues on is not a great deal; the amount that goes in the solution is a considerable quantity. I think I made some approximations on this tank we had that about half a pound of lead dissolved in each test.

The Court: It all goes— A. All goes into solution.

The Court: And nobody knows which molecule, and the molecule itself don't know which one is going to get over there? A. That is right, you couldn't tell. But, that acid—

The Court: How much is that true in ordinary plating, when you do plating does some of it generally stay in solution? A. Oh, yes, you have to keep a large reservoir of ions in solution: this is typical of plating, that is all it is.

The Court: And when you stop any plating you find some of the thing to be plated and— A. A larger amount in solution.

The Court: And in every case you put it in solution

first? A. Yes, and there is a great amount in solution compared to the amount plated out.

The Court: All right.

Mr. Owen: I think this is clear to the court, but I want to ask just one question on it, and that is to what do you attribute the protection which takes place in the pipe, or in the well tubing, after this acid which has been hauled about in one of these Menaul tanks leaves the tank and goes into the well tubing? A. I attribute it entirely to the inhibiting action of the lead chloride, copper chloride, that is dissolved in the acid, plus some little contributing effect of any oil that might be in the tubing.

Mr. Owen: That is clear to Your Honor?

The Court: Yes. Of course that stuff always does a little plating as long as there is any of it in solution? A. And it doesn't have to have another electrode to do plating.

The Court: I understand, and when they are both there they are both working at it? A Yes.

The Court: But all the connection does anyway is to put more of the chloride into solution and the more chloride you get in solution the better plating you have? A. And it helps out with its voltage, it has a voltage there that tends to give you a little more plating too.

Mr. Owen: And your opinion, as you expressed it in your previous testimony, is that there is no electrical protection afforded to the well tubing due to the connection of the tubing to the tank by the copper cable? A. That is my opinion from theoretical grounds, and from the result of the tests we ran.

The Court: How about this for a theory, does it hold or is it just a new one; that about all the connection does, it does two things, one is to keep putting more of the chloride into solution, it does that? A. Yes.

The Court: And putting more in and throwing them off it sort of creates a current across there and tends also in addition to increasing the percentage of the chloride, it creates a current that helps carry it over? A. That is the thing that I believe to be true. I said "voltage," you

say "current"; we mean substantially the same thing, an electrical effect, it both supplies the lead and copper in solution—

The Court: And while it is connected— A. It pushes it over there.

The Court: The current puts what is in solution across.

Mr. Owen: Now, you explained before that the theory of the Menaul patented process is that the current will follow the stream of acid down into the well and then jump across to the tubing and back to the tank? A. That is the understanding of the process in the tubing.

The Court: As I understand it, the plaintiff here uses arsenic?

Mr. Owen: We have used arsenic, Your Honor. We are not using it now.

The Court: If they use arsenic, they get the very kind of coating that you are talking about? A. That is right, here (indicating) but if they use the organic type, then they get a different type of coating, it is a different type of coating.

The Court: As far as you have used arsenic then, do you admit that you infringed the Gravell patent?

Mr. Owen: If that claim is valid—if that patent should be valid—

The Court (interrupting): But I am not talking about its validity.

Mr. Owen: Yes, that is right.

The Court: But as to the others, you claim that you do not.

Q. I would like to have you explain the methods of handling hydrochloric acid during manufacture, storage, shipment, and pumping, which are in common use and have been in common use for many years. A. Hydrochloric acid, or muriatic acid, is considered to be one of the most corrosive solutions that chemists and chemical engineers have to deal with, and the materials of construction that are used to construct the apparatus in which hydrochloric

acid solutions are handled have been merely for the storage of acid, let us take that first, wooden tanks, stoneware tanks, that is earthenware, brick-lined tanks, and rubber-lined tanks.

The Court: Did you leave out glass intentionally? A. Glass tanks we do not have, but we have glass-lined tanks that are also employed in some cases, that is with a special glass, vitrified glass lining in the metal, but large glass tanks are not available. Now, in the transporting—there is also another material that can be used, a material known as "Hovag," which is a phenyl formaldehyde or bakelite type of material that can be obtained in fairly good-sized tanks. Then for storage we use glass, for small storage like in carboys which are ten gallons or so, but I do not believe any glass containers are used above that size, for smaller amounts than that we usually use glass. That is for holding the acid. Then for transporting it, that is, conduit through which we can run the acid, we have glass tubing, such as Pyrex glass; we have rubber-lined steel pipe; we have ordinary rubber hose; we have Hovag piping, or Bakelite piping; we have hard rubber pipe, and those are the principal conduit materials that are used in transporting hydrochloric through a conduit.

Then, in the pumping of hydrochloric acid, the types of pumps that are usually used are, first, stoneware centrifugal pumps, and recently there have been glass centrifugal pumps come on the market. Rubber covered steel centrifugal pumps are used. And those types of conventional pumps are a conventional means of forcing acid through conduit.

There is also another type of pump that is hardly called a pump, the acid lift, in which you place acid in a container like a rubber-lined steel drum, heavy drum, and apply air pressure on top of the acid, and that forces the acid to whatever height you might want to force it, or through whatever conduit you might want to force it.

In the manufacture of hydrochloric acid, the materials that are used, the materials of construction that are used

in the plants that I have inspected—and I have inspected a great number and actually designed several plants in which hydrochloric acid was used—the hydrochloric acid is never allowed intentionally, in any case that I can remember, to come in contact with steel.

These various materials that I have described are used in the plant construction. There are other materials used also. For example, recently, there have been developed carbon tubes and heat-interchanges made of carbon impregnated with resins, and that material is resistant to hydrochloric acid and is being used to some extent.

The Court: That would go back to the— A. (Interposing): To the tubing. Under the conduits.

The Court: Conduits? A. But it is very seldom that they use that carbon tubing outside of a big jacket where they have a bundle of tubes, carbon tubes, which is used for heat interchange purposes.

The gases of hydrochloric acid, at high temperatures, are not nearly as corrosive as liquid, and there are parts of the hydrochloric acid manufacturing plant in which contact is made between the gases and some iron containing materials. For example, in one process, using the Mannheim furnace for the reaction of sodium chloride and sulphuric acid, which is one method of manufacture in steel, they actually use a cast-iron heavy bin in which this reaction is carried out, but the temperature is elevated and the material is not allowed to condense, and the rate of attack upon that iron is not as great as you would have if you allowed the vapors to condense and form a liquid at around ordinary temperatures or slightly above, to let the liquid react on the steel.

Now, there are recently—and this is particularly true in recent years, since this acid treating of oil well art has started, that people have started to employ in one or two processes only steel in contact with even dry hydrochloric acid, and there is one plant that is operating—I haven't seen it, but I have read descriptions—in Wyandotte or right outside Detroit some place—it is that Sharples Sol-

vent Company—in which they actually pass hydrochloric acid vapors, containing some moisture, through steel equipment that contains a large amount of chlorinated hydrocarbon that evidently protects the steel in some way from the corrosive attack.

The use of unprotected steel in chemical processes for the handling of muriatic acid, that is, the liquid solution, I cannot recall a single instance of that having occurred prior to 1930, and only this one instance—

The Court (interposing): What is that? A. Prior to 1930 I know of no single instance of the use of muriatic acid in contact with steel, and only this one instance, the Sharples Solvent, since that time. In most of the plants they avoid contact of steel with the muriatic acid.

The Court: Was this one in 1930 by putting an inhibitor in? A. No. They were chlorinating—this Sharples Solvent Company chlorinates pentane, and they get a mixture of chlorpentane in hydrochloric acid, and then, in the condensing system that they have, which condenses the vapors and separates the chlorpentane from the hydrochloric acid, they use steel equipment, and the explanation which they give—I haven't read the article recently, but as I recall it the explanation is that the oily chlorine compounds form a coating on the steel and inhibit what corrosive effect would occur.

The Court: When did you first hear of an inhibitor? A. When did I first hear of an inhibitor?

The Court: Yes. A. Quite a while ago. I can't recall.

The Court: Did you ever hear of the use of it? A. You mean use of it in a chemical plant?

The Court: Yes. A. I have never heard of the use of inhibited acid where they deliberately added an inhibitor.

The Court: For any purpose, now. A. No—well, now, of course—

The Court (interposing): When is the first time? A. The first time I heard of inhibitors of any kind?

The Court: Yes. A. Why, I learned about that when I was in college.

The Court: Yes. But when did you ever first hear of that being used in a business way; I mean not in a laboratory, but in a business, in a business way, to make any kind of use of an inhibitor. A. Well, that goes back, as I say, back into my college days.

The Court: What did they use it for? A. It is used as material to add to sulphuric acid pickling solution, so that the acid would not pit the steel but would dissolve off the rust. And that is the first instance that I can recall, and just when I heard of it, I can't recall now.

The Court: I was trying to carry the use on through the other uses. What other use did you ever know of an inhibited acid? A. That, as far as inhibited acid is concerned, I had not heard of any uses up until the time of the Grebe-Sanford patent. I was not aware of the work of the American Chemical Paint Company.

The Court: Or of this other patent? A. No. I was not aware of that.

The Court: There isn't any question but what this is an inhibited acid in the Gravell patent, is there? A. That is correct.

The Court: But you had not heard of that? A. I had not heard of that.

The Court: Or the use of it? A. Prior to 1930.

The Court: Never heard of storing acid in anything? A. Never heard of it.

The Court: So that it had evidently been going on for some time. A. Well, I don't know the exact time of the use. And it had not come to my attention. And one of the fundamental things that a chemical engineer has to know is the art of the corrosiveness of various materials under various conditions. In other words, the chemical engineer is supposed to translate laboratory results over into plant results, and he must know the art, all the different building materials and materials of construction and what they react to, and what is the common practice and knowl-

edge in the methods of handling corrosive materials. That is an essential part and a vital part of the knowledge of the chemical engineer.

It is the most fundamental part of all, I would say, to know just what materials you can use. And the general knowledge that I have, and I have kept abreast of the chemical engineering literature and with many chemical companies that are in this business.

I have been connected with at least three companies and possibly four that use hydrochloric acid, and several of them that make it and handle hydrochloric acid in their business, in a practical way and not in a laboratory way, and I have not heard of the use of inhibitor to store hydrochloric acid, by putting an inhibitor in hydrochloric acid that you could store it in steel equipment.

The Court: You are satisfied it could be done? A. I have testified that it can be done, it has been done since this Grebe patent has come out, when the Grebe patent came out—

The Court: Oh, it was done before the Grebe patent? A. I say, I didn't have any knowledge of that.

The Court: You didn't have any knowledge of that? A. I am testifying as to my own knowledge as a chemical engineer in the field of corrosive materials, that I did not—that I was not aware of that. But there are always things going on, to some degree, that of course one cannot keep in touch with all of them. I could not tell all of the different things that are going on in the whole field. But in conversations, and in my readings, I had not come across the idea that you could put an inhibitor into an acid and handle the acid safely in steel equipment, until this Grebe idea came out.

The Court: But Grebe had nothing to do with putting it in a tank and storing it? A. I know that, but when they started in on the Grebe process, they started to use steel tanks.

The Court: And that is the reason you found out about it, that you studied the subject then, when you were

employed by Dow at that time? If you had been employed sooner, you would have found out about it sooner? A. I don't think, Your Honor—

The Court (interrupting): Now, isn't that what fixes the date when you found out about it, was when you were employed by the Dow Company? A. Oh, no, I don't think so, I don't think it was.

The Court: Wasn't that the reason that you began to study it thoroughly at that time? A. No, I don't think so.

The Court: What has the Grebe patent got to do with finding out about storing it then? A. It has nothing to do with it. It hasn't anything to do with it.

The Court: That was the reason, though, that you found out about the storage at that time, isn't it; it was then that you began to study intensively that subject? A. No, I didn't start to study it intensively then.

The Court: Then what has Grebe got to do with finding out about storing this acid— A. (Interrupting): It has nothing to do with it.

The Court: But that was the first time you found out about it? A. That is exactly right, but my reason was that I saw them hauling out of the Dow plant steel trucks with hydrochloric acid in them, and that was a shock to me, and in discussions I found out that they were taking steel tanks and putting hydrochloric acid in them.

The Court: How do you suppose they found out that you could haul it in tanks? A. I don't know. That is something that is beyond me.

The Court: How long was that after the Gravell patent, that you saw them hauling it in steel tanks? A. I didn't see the Gravell patent.

The Court: The Gravell patent is dated July 31, 1928. How long after that was it before you saw them hauling it? A. It was around the—the first time that I was acquainted with the Grebe method was somewhere around within a year after the conception given here; it was in one of those summer periods that I saw and heard of it.

The Court: That would be about five years. A. I wasn't aware of the Gravell method. I never heard anybody else who referred to the Gravell method.

The Court: Wasn't that the Gravell method that you saw there? A. No, because they used a different inhibitor, as I understood it, they were using an organic inhibitor. I didn't know at the time anything about Gravell.

The Court: If they were using an acid inhibitor, then you saw the Gravell method for the first time five years after the patent, isn't that right? A. I don't believe the method of adding an organic material inhibitor follows Gravell.

The Court: Didn't they first put in arsenic over there at the Dow? A. I don't know whether—my recollection was that they used an organic inhibitor fairly soon, and it is difficult to tell when they used different inhibitors.

The Court: Which would be the best to use? A. What is that?

The Court: Which would be the best one to use, if there were not any patents in the world? A. I believe the best one to use would be the organic inhibitor.

The Court: For the whole thing, for everything in the world, too?

Mr. Lyon: Isn't arsenic a stronger inhibitor than the organic material? A. Well, I have seen hundreds of numbers of inhibitions and I just cannot remember.

Mr. Lyon: Well, the strongest combination is the one in the Gravell patent of the combination of arsenic in the organic material, isn't it?

CROSS EXAMINATION

By Mr. Lyon:

Q. According to the Gravell patent, the most powerful of the inhibitors is those, or are those that are provided by a combination of the organic type and of the metallic type. Is that not correct?

Mr. Owen: I object to that because this witness has

not undertaken to testify about the Gravell patent. I have not asked him about the Gravell patent. He has seen it, but he is not in a position to express an opinion as to what it covers.

The Court: Did you refer to any patent?

Mr. Lyon: I did not ask him what it covered. I said, "According to the Gravell patent" the strongest inhibitor would be that which was provided by a combination of an organic type and the metallic type inhibitor, and I am asking him if that is correct, if that combination is the strongest?

Mr. Owen: It would require him to examine the patent.

The Court: I will sustain the objection so far as it refers to that patent. As I understand it, Doctor, you have not prepared yourself on that? A. No.

The Court: But if you want to ask him—

Mr. Lyon: The fact?

The Court: I think that would fit in with what we have been talking about, if you want to examine him.

Mr. Lyon: Just drop out the "Gravell patent" and answer the question, as a matter of fact, if you can. A. The combination of the two would be better than one of them—that is, better than the organic type? Well, out of the organic type, you can get some very effective inhibitors; and out of the combined type you can get some very effective inhibitors; and just where the—whether one is above the other, or underneath the other, I have not got clear in my mind, but I don't think there would be a great deal of difference. If you were to take organic matter that was a very poor inhibitor alone, and would get it in contact with—mix it in with some metal, such as arsenic, you would probably get an increased effect over the arsenic. I am just bringing out in my mind some general ideas that I have accumulated. But if you take an inhibitor that is very good in its own right organically, then I am not sure that the arsenic would make it super-excellent above that.

Q. Well, arsenic is itself a very good inhibitor, is it

not? A. I believe that it is, under many conditions and many concentrations, quite good.

The Court: But it is, without any organic? A. Without anything; yes.

Mr. Lyon: And something has been said here to the effect that there is no perfect inhibitor, but if you would add one to five per cent of an arsenic compound you would produce, would you not, some reduction in corrosiveness by something above 97 per cent? A. I couldn't answer that question.

Q. You haven't made any tests on arsenic? A. I have seen figures with arsenic under many conditions and the variability is quite great under the conditions of the test.

Q. And you know that the plaintiff in this case advertises that its inhibitor is 99 per cent effective. Have you ever made any check to see whether that is true or not? A. I have seen some inhibitors that are that good.

Q. And some such as the plaintiff has used? A. Yes.

Q. And what kind of materials were those inhibitors? A. Oh, they probably were some of the organic type.

Q. Mercaptans? A. Probably.

Q. And in what per cent were they used? A. I don't recall that. The variation is quite considerable and there are a number of mercaptans they have used. It is difficult for ~~me to~~ give an exact answer. They have had at least ten or twenty different mercaptan products that have gone in in different amounts, different dilutions, with oil additions, small amounts, and so it is difficult for me to give any exact figures on it.

Q. You can't tell me to what extent the corrosion will be reduced if you employ from one to five per cent of arsenic acid? A. I would think it would be up around 95 per cent or so. That is just a wild guess without—it might vary from that by as much as three per cent either way, or four maybe, and that is on a small scale laboratory test, that is very questionable as to whether that exact figure applies in an oil well. I do not believe it does.

Q. And you are not prepared to tell us whether, if you

added to that arsenic oxide or arsenic acid some additional inhibitors of the organic type you would get a further reduction in corrosion? A. Well, I think in most cases—in some cases you would. But it is difficult for me to recall millions of compounds, as organic compounds, there are just millions of possibilities and practically every one of them is covered by Gravell or implied in Gravell, to give you a positive answer that the sum of them would—I think some of them probably reverse the action and lower it. The contact I have had with the work that has gone on is of the type of overlooking results and to just give a general picture of what is going on rather than to accumulate all of these specific facts.

Mr. Lyon: I am surprised, in view of counsel's statement a moment ago, and Your Honor's ruling, for the witness to now be volunteering as to what is in this Gravell patent and what is covered by it. He just made the statement of what the patent covers. A. I have heard the testimony. I have heard the things it covers read, and there is a multitude of things that I have read out of the patent, but I have not studied the specific compounds in the Gravell patent.

The Court: I don't think that is in conflict with his statement about it.

Mr. Lyon: Well, I don't have any more questions. I think the witness' summary of these other matters is fair from his standpoint. I think there is no use going over it again. He hasn't drawn any extreme or exact conclusions.

The Court: Well, I want to ask one more question, just to straighten it in my mind, but before I do that, Doctor, I want to assure you that lack of familiarity with some particular branch of a field as big and ramified as it is doesn't lessen my faith in the witness in the least degree or surprise me in the least degree. I certainly would not be able to tell you when our statutory laws, all of them, had been changed, for all I work at it all the while, and it is, I take it, just as big a field to work in as my field of the law. But I did want to be sure I understood your answer and that was whether

or not you hadn't used, known of an inhibitor to be used in connection with acids generally, is the way I understood it; that is correct; is it, until about the time of the Gravell patent? A. I had known of inhibitors, but most of that knowledge was an inhibitor in the pickling art with sulphuric acid, and I knew the action of inhibitors as a general class, but the thing of pumping acid down wells and handling it in steel equipment was new to me.

The Court: You weren't familiar, as I understood it, and I say it doesn't lessen my faith in your testimony at all, but I want to know, I understood, for instance, you didn't know about that Interstate Commerce regulation for shipment of sulphuric acid in steel containers? A. I knew in general that, but I didn't know specifically. I know in general what you can ship acids in, I don't know all the regulations, I know them in general.

The Court: I understood you to say that until the Gravell patent you didn't know that an inhibitor had been put in the stuff for the purpose of shipping it or storing it in any way until that time, except you did know of the use for pickling? A. I knew that, but I don't recall in 1930 that I even knew you could even ship sulphuric in drums.

The Court: In other words, your answer applied generally and not simply to hydrochloric? A. That is right.

STIPULATION RE EDWARD D. LUMAN TESTIMONY

It is stipulated by and between counsel for the respective parties that if Edward D. Luman were called by plaintiff and sworn as a witness in the above entitled cause, he would testify as follows:

That he is a resident of Dallas, in the County of Dallas, State of Texas, and that his address is care of The Atlantic Refining Company, Magnolia Building, Dallas, Texas, and that his education includes majoring in geology at the University of Kansas from 1914 to 1917 and at the University of Oklahoma during 1917 and 1918.

That he has been employed for approximately twenty-two (22) years by the Atlantic Oil Producing Company and the Atlantic Refining Company, and that his duties while with said companies from the time of his first employment up to the present were as follows: Employed by Atlantic Oil Producing Company (now The Atlantic Refining Company) as instrument man in March, 1919, for the purpose of operating an alidade. In May, 1919, he was promoted to the position of field geologist. From September, 1919, to August 1, 1920, he was field geologist in Oklahoma. August 1, 1920, to August 1, 1921, he was field geologist in Mexico for affiliated companies of The Atlantic Refining Company. August 1, 1921, to May, 1923, he was resident geologist in Okemah, Oklahoma. May, 1923, to February 1, 1924, he was field geologist in Venezuela for The Atlantic Refining Company. February 1, 1924, to February 1, 1926, he was paleontologist for Tulsa Division of the Atlantic Refining Company. February 1, 1926, to July 1, 1936, he was division geologist for the Tulsa Division, and from July 1, 1936, to December 31, 1940, he was chief geologist for the same company.

That at present his title is chief geologist for the Atlantic Refining Company, in charge of all geological, geophysical and scouting work of the Atlantic Refining Company in the states in which said company operates in the general southwestern part of the United States.

That at the time he went to work for the Atlantic Oil Producing Company in 1919, the business of said company was that of producing crude petroleum; that the Atlantic Oil Producing Company was a wholly owned subsidiary of the Atlantic Refining Company, and was absorbed by the parent company during the year 1936, and that the business of the Atlantic Refining Company from that date to the present has been that of producing and refining crude petroleum.

That at the present time the Atlantic Refining Company owns and operates oil wells in the States of Kansas, Oklahoma, New Mexico, Texas, Louisiana and Arkansas; that in all of those states said company owns or operates oil wells that are producing oil from limestone formations, and that such wells are located in the following identified states, oil pools, and counties and have been producing oil from the limestone formations recited since about the dates given, all as herein below indicated, and that these statements are based on the records of the Atlantic Refining Company and the Atlantic Oil Producing Company:

(Here follows a list of pools, formations and Atlantic Companies' operations substantially the same as that printed in connection the Blum stipulation, infra, pp. 1162 to 1165.)

That he is familiar with the practice of "Acidizing" or "Acid Treating" oil wells to increase their production; that he first became familiar with such practice during the year 1933; that the Atlantic Refining Company and the Atlantic Oil Producing Company have had many of their wells acidized; that this practice was begun in the year 1933 and that the Atlantic Refining Company has its acidizing work done by acidizing service outfits.

That among the first wells which the Atlantic Oil Producing Company had acidized were the following: Grimes No. 1, Hobbs Pool, New Mexico, in April, 1933, by Dowell, Inc.; Lido-Waggoner No. 1, Vernon Pool, Wilbarger Co., Texas, in August, 1933, by Dowell, Inc.; Barrow No. 1, Shipley Pool, Ward Co., Texas, in October, 1933, by Dowell,

Inc.; and Annie Jones No. 7, Bowledge Pool, Seminole Co., Oklahoma, in May, 1933, by Dowell, Inc.

That the Atlantic Oil Producing Company and the Atlantic Refining Company have had between 300 and 350 of their wells acidized, of which number about 200 have been acidized by Dowell, Incorporated.

STIPULATION RE HORACE M. STAGGS TESTIMONY

It is stipulated by and between counsel for the respective parties that if Horace M. Staggs were called by plaintiff and sworn as a witness in the above-entitled cause, he would testify as follows:

That he is a resident of Dallas, in the County of Dallas, State of Texas, and that his address is care of the Atlantic Refining Company, Magnolia Building, Dallas, Texas.

That his education and experience include Bachelor of Science degree in Mechanical Engineering from the University of Kansas in 1918; a course in the United States Bureau of Mines School, Carnegie Tech., Pittsburgh, Pennsylvania; assistant engineer of tests in the United States Bureau of Mines and Army Ordnance, and advanced training in metallurgy and metallography.

That he has been employed for approximately twenty-two years by the Atlantic Oil Producing Company and the Atlantic Refining Company, and that his duties while with said companies have been as follows: Employed by Atlantic Producing Company (now The Atlantic Refining

Company) in April of 1919 for surveying work (approximately one year); production superintendent, Kansas (approximately one year); superintendent of pipe lines, Haynesville, Louisiana (approximately one year); chief engineer, Atlantic Pipe Company (1922-1927); planning engineer for the Atlantic Producing Company (approximately one year); consulting engineer for the Pipe Line Company (approximately nine months); chief petroleum engineer for The Atlantic Refining Company from March, 1929, to 1936; general supervisor of engineering—Operating Department, The Atlantic Refining Company from 1936 on. That at present his title is general superintendent, and that he is in charge of all drilling, operating and engineering work of the Engineering-Operating Department of the Atlantic Refining Company.

That at the time he went to work for the Atlantic Oil Producing Company in 1919 the business of said company was that of producing crude petroleum; that the Atlantic Oil Producing Company was a wholly owned subsidiary of the Atlantic Refining Company, and was absorbed by the parent company during the year 1936, and that the business of the Atlantic Refining Company from that date to the present has been that of producing and refining crude petroleum.

That prior to 1916 neither the Atlantic Oil Producing Company nor the Atlantic Refining Company owned or operated any oil wells, and that this statement is based on the records of the said two companies.

That at the present time Atlantic Refining Company owns and operates oil wells in the States of Kansas, Oklahoma, New Mexico, Texas, Louisiana and Arkansas, and that in all of these states the Atlantic Refining Company owns or operates oil wells that are producing oil from a limestone formation, and that such wells are located in the following identified states, oil pools and counties and have been producing oil from the limestone formations recited since about the dates given, all as herein below indicated, and that these statements are based on the records of the

Atlantic Refining Company and the Atlantic Oil Producing Company:

(Here follows a list of pools, formations and Atlantic Companies' operations substantially the same as that printed in connection the Blum stipulation, infra, pp. 1162 to 1165.)

That he is familiar with the practice of "Acidizing" or "Acid Treating" of oil wells to increase their production; that he first became familiar with such practice during the year 1933, that The Atlantic Refining Company has a large percentage of its oil wells producing from limestone formations acidized or acid treated, which practice was begun in April, 1933, and that the Atlantic Refining Company does no acidizing of wells on its own account, but has the acidizing work done by acidizing service outfits.

That the first wells which the Atlantic Oil Producing Company caused to be acidized were acidized by Dowell, Incorporated, among which were the wells identified below, which were acidized on the dates indicated and that this statement is based on the records of the Atlantic Refining Company and the Atlantic Oil Producing Company: Grimes No. 1, Hobbs Pool, Lea County, New Mexico, in April, 1933, by Dowell, Inc.; Lido-Waggoner No. 1, Vernon Pool, Willbarger County, Texas, in August, 1933, by Dowell, Inc., and Barrow No. 1, Shipley Pool, Ward County, Texas, in October, 1933, by Dowell, Inc.

That the Atlantic Oil Producing Company and the Atlantic Refining Company have had about three hundred and forty of their wells acidized, and that of that number about two hundred of them have been acidized by Dowell, Incorporated.

STIPULATION RE EDWARD H. BLUM TESTIMONY

It is stipulated by and between counsel for the respective parties that if Edward H. Blum were called by plaintiff and sworn as a witness in the above entitled cause, he would testify as follows:

That he is a resident of Dallas, in the County of Dallas, State of Texas, and that his address is care of the Atlantic Refining Company, Magnolia Building, Dallas, Texas.

That his formal education consists of the following: graduate of Central High School, Philadelphia, Pennsylvania, and four years engineering studies at Temple University, Philadelphia, Pennsylvania.

That he has been employed for approximately the last thirty-five (35) years by the Atlantic Oil Producing Company and the Atlantic Refining Company, and that his more important positions while with said companies from the time of his first employment up to the present are as follows: Chief draftsman of Engineering Division of the Atlantic Refining Company for a number of years, made general manager of Atlantic Oil Producing Company in about 1918 and later also made vice-president and general manager of the Atlantic Oil Producing Company, subsequently became general manager then also vice-president of Atlantic Refining Company.

That to the best of his knowledge and belief the Atlantic Oil Producing Company was incorporated in about 1916, and that John W. Van Dyke, personally known by him, was the president of that company from about 1916 to 1936, and served as chairman of the Board of Directors of the Atlantic Refining Company from about 1927 to the time of his death in 1939.

That he was employed by the Atlantic Oil Producing Company from about 1916 to September 30, 1936, at which time said company was taken over by the Atlantic Refining Company; that from about 1918 to September 30, 1936, he was general manager of the Atlantic Oil Producing Com-

pany, and from about 1930 to 1936 he was general manager and vice-president of the Atlantic Oil Producing Company, and that from September 30, 1936, to the present time he has been a vice-president of the Atlantic Refining Company in charge of the domestic crude oil production of said company; that the business of said Atlantic Oil Producing Company was the production of crude oil and the business of the Atlantic Refining Company since his connection with it has been the production and refining of crude oil, and that said companies have operated in the following states and produced crude oil from the following pools therein beginning at about the dates indicated:

ARKANSAS

County	Pool	Formation	Date Atlantic First Operation
Columbia	Magnolia	Smackover	May, 1938
"	Dorcheat	"	August, 1939
Lafayette	McKamie	"	March, 1940

KANSAS

County	Pool	Formation	Date Atlantic First Operation
Rice, Ellsworth and Barton	Bloomer	Arbuckle	June, 1936
Rice	Brandenstein	K. C. Lansing	November, 1933
McPherson, Reno and Harvey	Burton	Arbuckle-Hunton-Chat.	June, 1933
Rice	Doran	Arbuckle	October, 1936
Stafford	Gates	Arbuckle	August, 1933
Barton	Hiss	K. C. Lansing	December, 1936
Pratt	Iuka	Simpson-Dolomite	October, 1937
Ellsworth	Lorraine	Arbuckle and K. C. Lansing	December, 1939
Rice	Lyons	Arbuckle and Simpson	August, 1936

Stafford	McNaughten	Arbuckle	April, 1937
Stafford	Rattlesnake	K. C. Lansing	October, 1938
Rice	Raymond	Arbuckle	August, 1936
Stafford	Richardson	Arbuckle	August, 1936
Ellsworth	Stoltenberg	Arbuckle	March, 1940
Ellis	Ubert	"	September, 1938
Rooks	Westhusin	K. C. Lansing	October, 1937
Finney	Nunn	Mississippi Lime	June, 1938
Scott	Shallow-Water	" "	January, 1935
Marion	Urshell	Galena (Viola)	September, 1920
Butler	Sensabough	Arbuckle	October, 1929

LOUISIANA

County	Pool	Formation	Date Atlantic First Operation
Claiborne & Lincoln	Lisbon	Petit	June, 1937

NEW MEXICO

County	Pool	Formation	Date Atlantic First Operation
Lea	Eunice	Permian	April, 1933
Lea	Hobbs	Permian	September, 1930
Lea	Lynn	Permian	January, 1938
Lea	Mattix	Permian	June, 1938
Lea	Penrose	Permian	January, 1938
Lea	Monument	Permian	November, 1936

OKLAHOMA

County	Pool	Formation	Date Atlantic First Operation
Okfuskee	Deaner	Waponucka Lime	1920
Pottawatomie	Avoca	Viola-Sandy Dolomite-Wilcox	August, 1928
Pottawatomie	Earlsboro	Hunton	February, 1928

Seminole	No. Earlsboro	Hunton-Wilcox	March, 1934
Seminole	W. Little River	Calvin & Wilcox	December, 1938
Stephens	Palacine	Pennsylvania Sand	March, 1930
Seminole	Wofford	Wilcox	April, 1935
Creek	Tuskegee	Meissner Sand	September, 1930
Seminole	Traugh	Simpson Dolomite & Wilcox	October, 1937
Seminole	Bowlegs	Wilcox & Hunton	May, 1927
Pottawatomie	St. Louis	Hunton & Simpson	September, 1927
Seminole	Seminole	Wilcox	February, 1927
Pottawatomie	No. E. Shawnee	Wilcox	August, 1937
Stephens & Carter	Sholem-Alechem	Pennsylvania Sands	January, 1927
Osage	Atlantic	Miss. & Arbuckle	April, 1922
Creek	Donnelly	Meissner & Wilcox	June, 1926
Creek	Mercer	Wilcox	February, 1924

TEXAS

County	Pool	Formation	Date Atlantic First Operation
Andrews	W. Andrews	Blaine	June, 1940
Crane	Church and Fields	Blaine	1927
Ector	No. Cowden	Blaine	1934
Ector	So. Cowden	Blaine	1934
Cochran Hockley & Terry	Slaughter	Clear Fox	November, 1939
Ector	Foster	Blaine	April 1, 1937
Ector	Goldsmith	Blaine	July 1, 1934
Winkler	Henderson	White Horse	May, 1936
Winkler	Hendricks	White Horse	June, 1928
Ector	Johnson	Blaine	February, 1939
Crane & Ector	Jordon	Blaine	March, 1938
Winkler	Leck	White Horse	August, 1930

Ward	Magnolia Sealy Co.	White Horse	May, 1940
Crane & Upton	McCamey	Blaine	December, 1926
Gaines	Seminole	Blaine	January, 1939
Ward	Shipley	White Horse	March, 1929
Ward	No. Ward	White Horse	December, 1936
Ward	So. Ward	White Horse	November, 1929
Winkler.	Kermit	White Horse	December, 1928
Willbarger	Vernon	Pennsylvania Sand	August, 1925

That all of the oil pools above listed produce crude oil from a limestone or calcareous formation.

That he is generally familiar with the method of treating oil wells producing from a limestone or calcareous formation with hydrochloric acid to increase the crude oil production of the wells, and that he first learned of or became familiar with such practice using raw hydrochloric acid during the period from 1910 to 1915, and that he first learned or became familiar with such practice using inhibited hydrochloric acid in 1932 or 1933.

That the Atlantic Oil Producing Company existed from 1916 to 1936 as a wholly owned subsidiary of the Atlantic Refining Company, carried on the crude oil producing business of said latter named company in the United States, produced crude oil from the various states and pools therein as above stated and did not have any of the oil wells it operated between the years 1916 and 1933 treated with hydrochloric or any other kind of acid with the object of increasing their production of oil; that the Atlantic Oil Producing Company first employed the practice of treating oil wells with acid to increase the production thereof in the year 1933 by employing Dowell, Incorporated, to acid treat with inhibited hydrochloric acid, among others, the following identified wells:

W. D. Grimes No. 1, Hobbs pool, New Mexico, in April, 1933.

Lido-Waggoner No. 1, Vernon pool, Wilbarger County, Texas, in August, 1933.

Barrow No. 1, Shipley pool, Ward County, Texas, in October, 1933.

EDGAR LEE,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

I live in Midland, Michigan, and have lived there all my life. I have been in the oil business and have drilled some wells. I cannot state the exact month, but in the summer of 1932 I started in the acidizing business and continued for perhaps a year. In this business I was associated with Mr. Dougherty and Mr. Fred Markey of Mt. Pleasant, Michigan. My association with these gentlemen was at first in the form of a partnership, and later we incorporated under the name of The Oil Makers. I think we incorporated in 1932, I just cannot remember. I was associated with Mr. Dougherty and Mr. Markey either as partners or as a corporation known as The Oil Makers for about a year and a half, perhaps, covering a period in 1932 and 1933. We were operating in Michigan and some in Texas and Oklahoma. We operated in the Greendale field of Mt. Pleasant, Michigan, and we also treated some wells in Muskegon, Michigan.

We were engaged in the business of putting acid into oil wells to try to increase the flow of oil by dissolving the limestone. We used hydrochloric acid. The first acid we used came from the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan. We first started to get the acid in a steel container, but the acid manufacturer would not supply the acid to us in that type of container on account of the fact that the acid was raw acid and they advised us to get wooden containers made and we did this. Mr. Parks, sales manager of the Pennsylvania Salt Manufacturing Company, said the raw acid would eat the steel tanks and he would not load the acid for us in those containers, so we had to have some wooden tanks made. We had a good steel tank which we sent to the Pennsylvania

Salt Manufacturing Company at Wyandotte, Michigan, and Mr. Parks, the manager, said they would not put the acid in the steel tank because he thought it would eat it out before we got the acid back to Midland. We had several wooden tanks made to haul the acid and used wooden tanks after that. These tanks were made for us by the Kalamazoo Tank & Silo Company at Kalamazoo, Michigan.

I have examined two invoices from the Kalamazoo Tank & Silo Company of Kalamazoo, Michigan, being orders No. 6318 and No. 6346, dated July 23, 1932, and August 11, 1932, respectively; and I recall that that is where we had these wooden tanks made, and these must be the dates on which the tanks were made. I had charge of buying these wooden tanks for this partnership or comapny. I went to the Kalamazoo Tank & Silo Company personally to order these tanks.

After I bought the wooden tanks I then went to the Pennsylvania Salt Manufacturing Company and bought acid, and put the acid in the wooden tanks and took it to Midland, Michigan, where I diluted the acid with water and treated wells with it. I and other of my associates had already heard of this business or method of using acid in oil wells. Mr. Sprenger, who was associated with us, had already treated some oil wells with acid, and also I think the Pure Oil Company had acidized some wells. We took the acid and put it into the wells, I think the first well we treated we didn't have any pumps. I think Mr. Sprenger syphoned the acid into the well. These wells were located in the Greendale field of Michigan and were owned by the McClanahan Oil & Gas Company. We were offering this acid treating service to the oil companies. We treated oil wells with acid for the McClanahan Oil & Gas Company, the G-Lee-P Company, the Gordon Oil Company, and then we treated some wells in Muskegon, Michigan. At this particular time my duties were that of treating wells with acid and trucking the acid from the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan, to the

oil fields in Michigan. Mr. Sprenger did most of the acid treating and I did most of the trucking of the acid.

When I called at the Pennsylvania Salt Manufacturing Company to purchase acid I just asked for acid. Mr. Parks, of the Pennsylvania Salt Manufacturing Company, telephoned us and cautioned us about getting the acid in a steel tank. This conversation was on the telephone. I was in Midland. Then I went down there to get the acid. Mr. Parks, the sales manager, said he would not load the acid for us into our steel tanks. I knew this because he called me and told me this over the telephone. Then I got the wooden tanks. When I bought the acid from the Pennsylvania Salt Manufacturing Company I just asked for acid, I guess. Mr. Dougherty and I went down to the Pennsylvania Salt Manufacturing Company to make arrangements to see about getting the acid. I do not remember the name of the gentlemen that we saw. We were supposed to get hydrochloric acid, because that was the acid they were supposed to use to treat the wells. We asked for hydrochloric acid because that is what we wanted to treat the wells with.

As a result of our treating wells in Michigan with hydrochloric acid, the prodution of the wells was increased. Some of the wells were increased a lot and some of the wells not increased so much. I know this because the operators gauged the tanks and because I was at some of the tanks when they were gauged.

I have made reference to the G-Lee-P Company. My name is Edgar Lee, and I have an interest in this oil company to the extent that I own some of its stock. This is an oil producing company. I own about $2,000 worth of stock in this company. The company has its wells in the Greendale field of Michigan. The Oil Maker Company acidized some wells for the G-Lee-P Company. I do not remember the names of these wells. I think, as a result of acid treating these wells, the production was increased, but I was not there when the gauging was done and I do not recall the exact amounts of increase. I would not care to state the exact increase. Mr. Walter Sprenger worked for the

G-Lee-P Oil Company and looked after the oil lease of this company on which the wells were treated by the Oil Makers Company.

We treated a well for the McClanahan Oil & Gas Company with acid wherein some damage was done to the pipe. I know this because I remember seeing the pipe afterwards and the pipe was pitted. By pitted I mean that the pipe looked as if little specks on it had been eaten away. This was the well tubing through which the acid had been introduced into the well. I did not put the acid into this well through the tubing, but I was there when it was done. I was not present when the tubing was taken out, but I saw the tubing afterward.

The Court: You don't know whether some of these fellows that were selling inhibited acid were there talking to him and telling him what a dangerous thing he was doing to use acid without an inhibitor? A. I presume some of the people were, yes, but that I couldn't say.

The Court: Were they around there selling the other kind of acid? A. You mean selling inhibited acid?

The Court: Yes: A. The Dow Company was selling their acid.

The Court: You have seen lots of pipes used long enough that would get rusted and pitted and everything else, don't they anywhere? These pipes don't last forever? A. No.

The Court: Do you know how old that pipe was? A. No, I don't.

The Court: You don't know what pitted it then? A. All I know is what he claimed, the acid did it, Your Honor.

Mr. Conner: Do you think it was right at that time that they were around there selling the inhibited acid? A. Yes, they all were selling it.

Q. And all those fellows selling inhibited acid were claiming that if you did not have inhibited acid, you would get your pipes eaten up? A. I presume they were, yes.

The Court: Those old pipes, after they have been used down there, acid or no acid, they are pitted up, aren't they, in time? A. I presume they are.

The Court: Haven't you seen many of them, being in that business? A. I am not in that business so much.

The Court: Can you tell a pipe that is pitted, from ordinary rust and wear of that kind, pitted by acid? A. No, I don't believe I could.

Mr. Conner: Now, Mr. Lee, as a member of this partnership, or of this Oil Maker Company, which was incorporated, did any complaints come to you, or to your company, that you learned about, as a member of that partnership, or as a member of that corporation, which complaints had to do with corrosion, or damage to the tubing, or other parts of a well, as a result of your company treating those wells? A. McClanahan, G-Lee-P, and I think the Gordon Oil Company, and I believe there was somebody in Muskegon.

Q. Did you ever make any settlement on such complaints? A. Well, I think that we paid for some tubing in some place, and then I think the way—

The Court (interposing): I think you had better tell the name of that place, and the time, and something about it, so that it can be verified. You use the words "I think." A. Well, Your Honor, I don't remember that, Your Honor.

Mr. Conner: I have a witness here who can tell all about that, and I will show the names of the companies, but I am now trying to get a complete picture of this, to show that you cannot use raw acid in Michigan wells.

Mr. Lyon: Do I understand that you do not rely on this witness, and—

Mr. Conner (interrupting): I am relying upon everything he says. He is a member of the partnership, and he knows all about this, and he knows that complaints came in there, as he has stated.

The Court: Well, he has not named but one, well, that isn't by name. There is only one that he said came to him.

Mr. Conner: Did you see the tubing, or any tubing, or any part of the well equipment in the G-Lee-P Company's wells? A. No, I did not.

Q. So that you do not know the extent of their corrosion? A. No.

Q. You do know, however, from talking with your associates, that there were complaints to a certain extent, but to what extent you don't know, with respect to corrosion troubles? A. Yes.

Mr. Lyon: I object to that. We are after actual knowledge, and not anything as to any legal partnership, or as to what may be imputed to a partner, or anything like that.

The Court: I will let it stand, but I will agree with you as to the evidentiary weight of it.

I cannot state for how long a period of time we purchased acid from the Pennsylvania Salt Manufacturing Company. We did not purchase all of the acid that we used in treating wells from this company. At the last we bought our acid from the Grasselli Chemical Company of Cleveland, Ohio. The Grasselli Company claimed that they had an inhibitor in their acid that would do away with the trouble that we had been having, and that was the reason we changed our source of supply for acid.

I have previously seen the letter on the letterhead of The Dow Chemical Company, dated September 23, 1932, and addressed to The Oil Makers, Inc., Mt. Pleasant, Michigan, and signed Willard H. Dow.

At this point PX-197 and PX-198, the two invoices from the Kalamazoo Tank & Silo Company, No. 6318, dated July 23, 1932, and No. 6346, dated August 11, 1932, were offered and received in evidence. Also offered and received in evidence was PX-199, being the letter dated September 23, 1932, on a letterhead of The Dow Chemical Company, and addressed to The Oil Makers, Inc., Mt. Pleasant, Michigan, and signed by Willard H. Dow.

The witness thereupon read the letter from Willard H. Dow (PX-199) to The Oil Makers Company, as follows:

"Oil Makers, Incorporated,
Mount Pleasant, Michigan.

September 23, 1932.

Gentlemen:

"Attention: Mr. Charles Dougherty.

"We are advised that you are infringing United States Patent 1,877,504 issued to this Company and entitled 'Treatment of Deep Wells.' For your information, a copy of that patent is enclosed herewith.

"You are respectfully requested to immediately discontinue the use of acid in any manner which will infringe the rights secured to us by the aforesaid patent. We will appreciate an early acknowledgment from you and trust that it will be unnecessary for us to take any legal steps to enforce our rights under this patent.

"Very truly yours,
The Dow Chemical Company
Willard H. Dow
President and General Manager."

(Here PX-197, 198 and 199 were offered and admitted.)

The Court: You didn't read the date. A. Beg pardon. September 23rd, 1932.

The Court: September 23rd. What is the date of those invoices?

Mr. Conner: The date of the first invoice is July 23, 1932, and that is PX-197.

The Court: Yes. And the next one?

Mr. Conner: Plaintiff's Exhibit 198 is dated August 11, 1932.

The Court: What is the date of the purchase from Grasselli at Cleveland? A. I can't give the exact date.

The Court: That is the important date.

Mr. Conner: That is the important date. I will show that later. I will show it at a later time.

The Court: What is it?

Mr. Conner: Just to give you a resume of what I hope to show, I will show this company started acidizing wells

some time in June of 1932, and it did a little bit of business in that month, and continued through July and all of August, and during that time bought all of their acid from the Pennsylvania Salt Company at Wyandotte, Michigan. Now, that was raw acid, I hope to prove. Then after August 31st they then started buying acid from the Grasselli Company beginning in September of 1932.

The Court: What time in September?

Mr. Conner: That will depend on the invoices I have here, as well as the checks for payments. The first check I have to Grasselli is dated September 19th, 1932.

The Court: Well, now, Mr. Dow—I am just getting it. Mr. Dow is a mighty quick acting chap, but he never got that invoice of September—what it it, September 19th? He never got around through his law department and everywhere else to notify them of that infringement. He is notifying them and there are some things you indicate you know you had a good patent on acidizing wells. Did they say anything to you about it or have any talk with him about this, about what you were doing? A. Just the letter is all.

The Court: What kind of acid were you using before that? Here you get a letter September 23, 1932, telling you you are infringing the patent. What kind of acid had you been using? A. We had been using the raw acid first, and the acid—

The Court (interposing): Up to that time, I am talking about? A. I don't know whether we were using inhibited acid then or not. I don't remember what the date on that was or when we got our first acid. The invoices would show.

The Court: Well, what did you understand you had been ordered to stop doing? A. Not to be treating wells.

The Court: At all? A. Yes.

The Court: Well, that is the way I would understand it. It doesn't say anything about inhibition in your letter.

Mr. Conner: Oh, if Your Honor please, this letter, to my recollection, states that it is notice of infringement,

mentioning United States Patent 1,877,504, which is the very patent here in suit.

The Court: I know it, but then they evidently are getting after them if they know they are acidizing wells to notify them. I don't think that amounts to anything.

Mr. Conner: That is as it may be.

The Court: Because the plain conclusion to be drawn from this is that they have been using acid that was not inhibited at all, and bang, they notify them to quit. Quit what? Quit acidizing wells.

Mr. Conner: Well, if Your Honor will keep in mind the month of August and July of 1932, I think I will be able to show you which acids they were using in August and which acids they were using in September, I mean, and from whence those acids came and just what they were.

The Court: All right.

At this point PX-200, a letter dated October 14, 1932, addressed to the Oil Makers Company, Midland, Michigan, attention Edgar S. Lee, and signed F. C. Zebornick, of the Grasselli Chemical Company was offered and received in evidence.

The Witness: I have seen this letter before which reads as follows:

October 14, 1932.

"Oil Maker Company,
Midland, Michigan
"Gentlemen:

"Attention: Mr. Edgar S. Lee

"The writer happened to be in touch with our Cleveland office today and was informed that our legal department is forwarding you a letter today, which will give you necessary protection against infringement of Dow's patent in using or selling Duclean 2-A for treatment of oil wells. We trust this document will be found satisfactory and that you will be able to go ahead with any and all plans you have in mind for the promotion of our Duclean 2-A.

"We understand from our Mr. Fisk, who interviewed you the other day, that you propose making another visit

to the Cleveland office with the idea of ironing out matters pertaining to other fields.

"We certainly appreciate the attention you are giving this item and assure you we will be glad to lend you whatever co-operation will be required to enable you to get your share of business.

"Thanking you, we remain,

"Yours very truly,
The Grasselli Chemical Co.
F. C. Zebornick,
Branch Manager."

At this point PX-201, a letter dated November 21, 1932, from the Grasselli Chemical Company of Cleveland, Ohio, addressed to Edgar S. Lee, of the Oil Makers Company, Midland, Michigan, and signed by Grasselli Chemical Company, H. M. Rosencrans, was offered and received in evidence.

The Witness: I have seen this letter before, which reads as follows:

November 21, 1932.

"Mr. Edgar S. Lee
Oil Maker Company,
Midland, Michigan

"Dear Sir:

"I have your letters of October 26th and October 31st, the former in reference to the G-Lee-P Company and the latter referring to the Gordon Oil Company. In our guarantee to you covering protection against the Dow patent, you will note that we have not only guaranteed protection to you, but also to any of your customers which you supply our product to and we see no reason why you should not explain this to your customers who have received these letters from the Dow Chemical Company and as a matter of fact we have no objection to you showing them the letter in substantiation of your position with us in connection with this patent and also your position with us in connection with your customers.

"Should any of your customers at any time receive official notice of suit being filed against them, they should, of course, refer any and all correspondence to you immediately and you in turn pass it along to us.

"Yours very truly,
The Grasselli Chemical Co.
H. M. Rosencrans,
Western Division Sales Manager."

The Court: Were you receiving threats during the time you were using that acid you bought down in Detroit? A. I don't remember, Your Honor, whether we received letters then or not. It seems to me these people we treated for received letters, but I couldn't give you the date they received those.

The Court: You were having trouble then in your field about your acid, and by trouble I refer to from the Dow, before you bought that inhibited acid, and you were using the regular acid, were you not? A. You mean we were having trouble from the Dow?

The Court: That is open to all the objections they urged against your question, but it is of the same type, it is that hearsay type. Were you having trouble out there from the Dow while you were using that acid you bought in Detroit? A. I couldn't say. I don't remember whether we had the letters then or after we used from Grasselli.

The Court: Before you had letters were there men selling acid to your customers? Were you getting complaints back from your customers that they were getting scared? A. On Dow's patent?

The Court: Yes. A. I couldn't say. I don't remember at that time.

The Court: All right.

Mr. Conner: I show you another letter on the letterhead of the Grasselli Chemical Company, dated January 26, 1933, addressed to Edgar Lee, the Oil Maker Company, Mt. Pleasant, Michigan, signed the Grasselli Chemical Company, H. M. Rosencrans, and ask it be marked as PX-202,

and I ask you, Mr. Lee, if you have seen that letter before, and if so, approximately when?

(The letter above referred to was thereupon marked Plaintiff's Exhibit No. 202.)

Mr. Owen: May I suggest right here, Your Honor, that the Grebe-Sanford patent did not issue until September 13, 1932, so there couldn't have been any notice of infringement before that time.

Mr. Lyon: They could talk about the fact they were going to get a patent and sue as soon as they got it.

Mr. Owen: They didn't know they were going to get one.

Mr. Lyon: They claimed they were.

The Court: What is the date of the Grebe patent?

Mr. Owen: September 13, 1932.

The Court: Well, now, that looks to me as if Mr. Dow as quick as he found out he had a patent sent out his notices to everybody in the field, rather than that he had just found out two days before or three days before he had ordered some inhibited acid from Cleveland.

Mr. Conner: That could well be. We don't know.

The Court: I say that is what it looks like.

Mr. Conner: We do not know.

The Court: It doesn't look as if the fact they had shifted from the clear acid to the other, or had heard about the use of that clear acid, and he didn't know whether it was inhibited or not?

Mr. Conner: It could well be.

The Court: I think that is the common sense conclusion to reach from that discussion.

Mr. Conner: Yes, I am inclined to agree with you. I don't think the Dow Chemical Company knew what kind of acid was being used.

The Court: They knew they got a patent and they knew their acidizing was not it.

Mr. Conner: One of those two things, or both of them.

Mr. Wiles: Our notice was limited to reference to the patent. It is the common type of practice, if you are using anything in here you get off.

The Court: All I was drawing a conclusion that what I was guarding myself against was reaching the conclusion that there is any inference that the Dow Chemical Company thought or knew that this was inhibited acid, or had any reason to think it was at the time they sent that notice.

Mr. Lyon: Their position today seems to be about the same as that. They want to put you out of the acidizing business, not out of the use of the inhibitor.

The Court: They have got some of yours and analyzed it, but I don't think they had then.

Mr. Lyon: It took a long time to invent a theory of infringement for this case.

Mr. Wiles: It took a long time to get a sample. The minute a sample was gotten it was clear enough it was infringing acid.

The Court: I think we are all in agreement about what happened about these notices, and I was just emphasizing there that it doesn't look as if the change in the use of that acid that came in there about that time had anything to do with this notice, and that what that notice was based on was the use, as a matter of fact, of the acid that was not inhibited.

Mr. Conner: To be perfectly frank with you, Your Honor, I don't contend one way or the other, but I think when I get through with my proofs here you can make your decision for whatever phase of the matter or in whatever phase of the matter it affects this case.

The Court: I better wait and not make it now.

Mr. Conner: You rush me.

Mr. Conner: Will you please read this letter, Mr. Lee?

"January 26, 1933

"Mr. Edgar Lee,
"The Oil Maker Company,
"Mt. Pleasant, Michigan
"Dear Sir:

"As a matter of record we want to confirm conversation which we had with Mr. C. I. Dougherty on Monday, January 23, at which time we told him that our letter to you

in connection with the Dow patent on the use of inhibited muriatic acid in the treatment of oil wells, does not in any way cover anyone who would buy our Duclean 2-A from you, and use it in the treatment of oil wells. In other words, should you re-sell any of this product of ours, we can assume no responsibility in connection with the party to whom you sold it.

"I very much enjoyed meeting Mr. Dougherty and talking with him about the Texas and Louisiana activities, and the next time you come north, I would also enjoy having a little visit with you. I get over to Detroit quite frequently now and might be able to meet you there if you would let me know a few days ahead of time.

"Yours very truly,

"The Grasselli Chemical Company

"H. M. Rosencrans."

The Court: If I interpret that letter right they gave you protection. If you sold to other people they didn't believe their guaranty would go to them. A. As I remember it, we had some people that wanted to buy this acid and treat their own wells, and we asked them if they would still be protected against Dow's patent.

The Court: All right. A: I think that is the way it is.

At this point a letter on the letterhead of the Grasselli Chemical Company, dated September 15, 1932, from F. C. Zebornick to E. J. Lee, Midland, Michigan, and a letter dated October 8, 1932, addressed to the Grasselli Chemical Company, Cleveland, Ohio, attention Mr. Rosencrans, and signed the Oil Makers Company, Edgar S. Lee, were offered and received in evidence as PX-203 and PX-204.

The witness then read the letter (PX-203) as follows:

"September 15, 1932.

"E. J. Lee,
"Midland, Michigan
"Dear Sir:

"Shortly following our 'phone conversation this morning, the writer wired you as follows:

'Okeh to see our Mr. Rosencrans tomorrow at Cleve-

land office.' Confirmation of which we now attach hereto.

"We have already explained to our Mr. Rosencrans that it is your desire to discuss the subject of the use and purchase of inhibited muriatic acid for Kentucky and other districts.

"Hoping your visit will prove satisfactory and thanking you for giving us the opportunity to interest you, we remain

"Yours very truly."

The Witness: With respect to the carbon copy of the letter dated October 8, which is PX-204, I will state that the carbon copy I have here is a copy of the letter I sent on or about that date to the Grasselli Chemical Company. I will now read the letter.

"Midland, Michigan, October 8, 1932.

"Grasselli Chemical Company
"Cleveland, Ohio.

"Attention Mr. Rosencrans.

"Dear Sir:

"We would like to have you write a letter to Mr. H. C. Spillman of the Continental Motor Company of Muskegon, Michigan, telling that your inhibitor is 98 per cent perfect, and will form no corrosion or harm pipes in any way. Please write Mr. Spillman at once as he has about twelve wells to treat and is awaiting your reply before giving contracts for treating them.

"We will want another car of acid the first of the week, and will mail you a check for the car on Tuesday.

"Yours very truly,
"Oil Maker Company,
"Edgar S. Lee."

The Witness: As I understand it the Duclean 2-A was 98 per cent perfect. Well, anyway, it would not eat up the pipe up to 98 per cent. I am not a chemist. I cannot explain it to you in those terms. It was 2 per cent from being perfect. You could throw pipe into your acid and practically no harm would come to it at all.

The Court: How did you happen to have any worry up in Muskegon about that, anyway? What started that about your acid going to eat it up? A. I think we used some raw acid over there first.

The Court: Hadn't anything been eaten up yet? A. We had trouble there.

The Court: Trouble making sales and getting jobs is all. A. No, as I remember, we had trouble with pipe and tubing. I think Mr. Dougherty looked after that.

The Court: You were trying to make another sale over there. A. That is true.

The Court: Well, did you have any competition? A. Yes.

The Court: What was your competition? A. The Dow was treating.

The Court: And who was talking about pipe standing up? What started that talk? A. Well, as I remember, we had some trouble with tubing over there on another lease. This man was a little leery of this acid we used.

The Court: What made him leery? What started that talk? Do you know? A. I couldn't say. He talked to some of these other men, treaters that owned other wells.

The Court: Some of your competitors you mean? A. I wouldn't say that because I wouldn't know.

The Court: It sounds so to me. You are trying to sell your acid. You are trying to get your man to write him a letter about acid 98% pure. A. Sure. That's right.

The Court: Do you know how he happened to find out that the pipe had been eaten in the well? A. You mean this gentleman here?

The Court: The Muskegon man. A. The man we had Grasselli write the letter to?

The Court: Yes. A. I don't think we treated any wells for him. We were trying to get to treat his wells.

The Court: What started him worrying about the well being eaten up with acid? A. Nothing. Unless he started to talk with the other men in the field that had had wells treated.

CROSS EXAMINATION

By Mr. Lyon:

Q. When you got this letter from The Dow Chemical Company calling attention to infringement of the patent in the middle of 1932, did you get a copy of the patent? A. No.

Q. Didn't pay any attention to the patent?

Mr. Wiles: The letter says the patent is enclosed.

A. The letter may have said.

Q. Did you read the patent, attempt to find out what the patent covered? A. I don't remember.

Q. Did you take it to any attorney? A. No.

Q. You didn't make any investigation to see what that patent covered at all? A. Not to my knowledge, no.

Q. At that time your company wasn't in very good financial position, was it? Didn't have money to spend on lawyers or anything like that? A. That is right.

Q. Pretty far behind on your accounts in paying for this acid, weren't you? A. No.

Q. Weren't you behind with the Pennsylvania Salt Company? Didn't they refuse you credit? A. I don't believe they did.

Q. Don't tell me you don't believe they did. Didn't you have to go to Grasselli because Pennsylvania Salt refused you credit?

The Court: How much money did you have? A. Not very much, Your Honor.

The Court: How much? A. \$500 or \$600.

The Court: All told? A. Yes.

The Court: That was your capital? A. Yes.

Mr. Lyon: Now, when you proposed bringing this acid up from the Pennsylvania Salt Company in this steel tank, whose idea was that? A. Why I guess it was Mr. Dougherty's and mine.

Q. Did you see anybody else using steel tanks around your part of the country? A. No, I don't believe we did.

Q. What was Dow using to deliver their acid? A. I don't know.

Q. How did you get the idea of using the steel tanks instead of a wooden tank? A. We didn't know. We just got a tank. Nobody knew nothing about the acid business at that time.

Q. Did you pay for having a steel tank made? A. No. We bought it.

Q. How much did you pay for it? A. $30.00, $35.00 for it.

I do not know why we wished to ship the acid in a steel tank. A wooden tank cost, according to the invoices, $150 to $154. I do not believe that we compared the wooden and steel tanks before we went to the Pennsylvania Salt Manufacturing Company for the acid. Mr. Dougherty and I first went down to the Pennsylvania Salt Manufacturing Company to arrange for buying some acid. We asked for acid that was used to treat wells. They knew what we would want down there. I do not know whether they were also selling acid to other people for treating wells at that time.

When we sent the steel tank to the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan, to obtain hydrochloric acid in it, Mr. Parks, their general manager, called us up and told us that he would not ship the acid for us in a steel tank because it would eat the tank up before we got it back to our place. I am sure that he said that. I have not had any experience to know whether or not this would be true. I have never tried it. It would take about six hours for the acid to come from Wyandotte, Michigan, up to our place at Midland, if we were going to haul the acid in that steel tank. I do not know how thick the steel tank was. It was an oil tank that we got from the Standard Oil Company at Saginaw. I think the tank was about ¼ inch thick, but do not know how old it was, but it was a clean tank. It had been painted and it looked like a good tank.

When we bought the two wooden tanks from the Kala-

inazoo Tank & Silo Company, one invoice stated "Paint inside of tank with asphalt paint" and the other invoice stated "Paint inside of tank as per wire." I do not know why they did this. I suppose it makes the tank more waterproof, or perhaps the acid doesn't eat the wood. I couldn't say. Maybe it makes the tank last longer.

I cannot say when we actually stopped this acidizing business and went out of business and discontinued treating wells. I do not know the last well that we treated or on what date it was. As nearly as I can remember we discontinued this business after the banks closed, which was about February, 1933. I do not believe we still had our $600 in the bank when we quit business.

Mr. Lyon: You had a guaranty from Grasselli, and you had an inhibited acid, what did you go out of business for? A. Well, oil went down to 10 cents a barrel, and the banks closed up.

Mr. Lyon: You said that there was some trouble about something that you had done with this Penn Salt acid. Do you really know about that trouble, or is it very vague in your mind? Can you give us the facts about it? A. Well, the only facts that I can give you is that the only pipe I saw was this pipe that came out of the McClanahan well.

Q. Now, were you there when the McClanahan well was treated? A. Yes.

Q. How long was the acid in that pipe going down the well? A. Oh, probably two or three hours they were putting it in.

Q. How long was it in? A. Maybe two or three hours.

Q. I am not asking you maybe.

The Court: Well, as near as he can tell. A. I can't give you the exact minutes or time.

The Court: It was about that as near as he can tell.

Q. All right. What kind of tubing was in that well, do you know what size it was? A. I believe it was a 2-inch.

Q. Was it new tubing? A. That I couldn't say.

Q. Do you know what condition the tubing—how long

it had been in the well before you acidized the well? A. I couldn't say that either.

Q. You don't know anything about the tubing before you acidized—the condition of the tubing? A. No, I couldn't tell you.

Q. When you saw this tubing after the job had been done, were there any holes in it? A. No, there was not. There were little pits in it. The pieces that I saw that their man showed me, there were little pits in it. I didn't see the working barrel. All I saw was a few lengths of tubing.

Q. How thick was that tubing? A. It was regulation size tubing. I couldn't give you the exact thickness.

Q. About a quarter of an inch thick? A. I don't think tubing is that thick.

Q. How thick was it? A. I couldn't give you the exact measurements, because I don't know.

Q. It was just pitted a little bit on the inside? A. This was on the outside that I saw.

Q. Pitted on the outside. You didn't get your acid pumped away from the tubing? A. Perhaps not.

Q. Was there any pitting on the inside of the pipe, or did you look? A. I don't know. I just saw these two or three lengths of pipe that this man showed me.

Q. Was there any complaint about pitting on the inside of the pipe in any of these cases that you talked about? A. You mean in this case here or do you mean on the inside of the pipe?

Q. The acid goes down the inside or outside, which? A. Goes down the inside. Sometimes they don't use any tubing at all.

The Court: Where did you put it down? A. This well, it was put down through the tubing.

Mr. Lyon: Was there any complaint that the acid had hurt the tubing on the inside? A. I wouldn't say about the inside.

Q. Was there any complaint about the inside? A. That I couldn't say. It was the outside that he showed me and complained about.

Q. How many joints up from the bottom was he complaining about it on the outside of his tubing? A. He showed me two or three joints.

The Court: From the top of the well or bottom? A. That came out of the bottom, he said.

Mr. Lyon: And tell the court how much pitting you saw there on the outside of the pipe? A. We saw pitting on this bottom pipe, not so much.

Q. Do you think there was an alarming amount of pitting? A. There was some, yes.

Q. How much? A. I couldn't describe to you how much, but there was some pitting on the pipe.

Q. How deep were the pits, do you know? A. No, I couldn't say.

Q. Were they very deep, or don't you know? A. I don't know.

Q. Had the pipe been cleaned up when you saw it, these joints of pipe cleaned up? A. I don't believe so. It laid there on the rack.

Q. Were they rusty or not? A. I don't remember.

The Court: The man is here that showed it to you? A. No, this man isn't here.

Mr. Lyon: Well, who was present when you saw this pitted pipe, anybody but you and this other man? A. When I was there that was all, but I believe Mr. Dougherty and Mr. Sprenger saw this pipe also.

Q. Are they here? A. Yes. I wouldn't say for sure, because I don't know.

Q. They didn't see it when you saw it? A. No.

The Court: Where is that man that showed it to you? A. I don't remember his name.

Mr. Conner: Do you remember the name of that well in the McClanahan? A. I think it was the Schaffer well.

The Court: Is that the one he was talking about?

Mr. Conner: Yes.

Mr. Lyon: Can you tell us the date on which you acidized that well? A. No.

Q. Can you tell us the name of the company you acidized it for? A. McClanahan.

Q. Can you give us the location of the well? A. It is in Greendale.

Q. Is that as near as you can locate it? A. It is between Midland and Mt. Pleasant, about twelve miles out of Midland, on the Mt. Pleasant Road.

The McClanahan Oil & Gas Company has more than one well located in this district. I think Mr. Sprenger put the acid into this well. I do not remember the name of the McClanahan Oil & Gas Company's field man that was in charge of this well. I think it was the Schaeffer well, but I wouldn't say for sure. I do not remember the date when the well was treated, nor can I tell you the date when I went out there and looked at this tubing. It was perhaps a week or ten days after the job of acidizing this well that I went out and looked at the tubing.

Mr. Lyon: Did you actually reimburse these people or pay them anything for this damage you did outside of this tubing? A. It seems to me that we done—the way we paid some of them, we done some free treating for them.

Q. Did you do that for these people you were talking about? A. I believe we done some free treating.

Q. Well, did you for this company? A. I wouldn't say for sure, but I am under the impression we did.

Q. Well, did you pay them any money? A. No, I don't believe we paid them any money.

Q. Well, what did you treat for them free and when? A. That I couldn't say.

The Court: With the same kind of acid? A. I don't know what acid we did use afterwards.

Q. How long after you saw this damaged tubing was it before you did this free treatment? A. I can't remember.

Q. Did you produce all the letters and correspondence you had with Grasselli about this acid that you were going to buy from them? A. Do you mean the letters and correspondence you have here?

Mr. Conner: I submit this witness didn't have custody of these letters, and I will put the gentleman on the stand who did and you can ask him.

A. (Continued): I had no letters, no.

Q. These letters, many of them were addressed to you personally? A. That is right.

Q. Where is your file? A. Mr. Dougherty had the letters and things at Mt. Pleasant after we moved there.

Q. Do you know whether this is all the correspondence you had with Grasselli on this subject? A. I couldn't say. I don't remember.

Q. Now, you started in acidizing wells, or formed this little business what time, in June, 1932? A. Oh, I wouldn't say the exact date of it, because I don't remember that.

Q. Well, as near as you can. A. It was in the summer of 1932.

Q. As near as you can when was it? A. It might have been June, July; in there some time. It was in the summer I know.

Q. Is that as near as you can fix the date? A. Yes.

Q. Now, was there anybody else in the acidizing business at that time, or any companies acidizing their own wells before you went into the business? A. It seems to me that the Pure Oil Company were acidizing their wells.

Q. Had Dow started anything when you went into business? A. I don't remember.

Q. But the Pure Oil Company, that was where you got the idea of acidizing wells, from the Pure? A. Why, I don't know where the idea really did originate from.

Q. I mean so far as you are concerned, where did you get the idea? A. Well, we have discussed it among ourselves, that is all. Mr. Dougherty is an oil man, and Mr. Sprenger.

Q. It was not your idea then? A. No, I guess it was all of their idea.

Q. How did you come to get into this thing? A. I knew Mr. Sprenger and Mr. Dougherty, and we had been interested in some oil wells.

Q. Who suggested that you go into the acidizing business? A. I do not know.

Q. Do you know whether you did, or not? A. I couldn't say.

Q. Did you ever take up with the Penn Salt Company, or, did you ever report to the Penn Salt Company, or advise them that you were having any trouble, or any complaints about their acid causing any pitting of any pipe? A. I don't remember.

Q. Or any damage to any pipe? A. I don't remember.

Q. You do not remember? A. No.

Q. Did you advise the Penn Salt Company why you were discontinuing buying acid from them? A. I think we told them that we wanted an inhibited acid, sir.

Q. And did they say that they would not give it to you? A. I don't think they had an inhibited acid.

Q. Did you do this in writing? A. No, I don't believe it.

Q. Did you personally go down and talk to the Penn Salt Company about inhibited acid? A. I talked to their man once about if they had inhibited acid.

Q. What man? A. One of their chemists. I don't remember his name.

Q. Where was this conversation? A. That was in one of their offices, in the Penn Salt.

Q. And when was that, about when relative to these other things? A. It was in the summer some time.

Q. Was there anybody else using inhibited acid up in your territory in the summer of that year? A. I don't know.

Q. Where did you get the idea about inhibited acid, where did you hear about it? A. I think Grasselli's men were around up in there selling it, and I think they contacted us first.

Q. What Grasselli men came to you? Did Grasselli men come to you and tell you that you had better buy inhibited acid, instead of the Penn Salt uninhibited acid? Is that right? A. They came to sell their acid.

Q. The sales point that they made to you that it was inhibited? A. They had an inhibited acid, yes.

Q. And that was the first time you ever heard of it? A. Of inhibited acid?

Q. Yes. A. I don't remember.

Q. You had never bought any inhibited acid up to that time, that you know of? A. No.

Q. Did they tell you that if you bought inhibited acid from them, then you could go out and use that sales argument with your customers that you had an inhibited acid? A. I believe that was one of the arguments, yes.

Q. You never gave the Penn Salt Company an opportunity to demonstrate to you whether their acid would injure pipe in a substantial way, or gave them an opportunity to say whether they would furnish you with inhibited acid? A. As I remember it, I don't think they had inhibited acid, or didn't want to bother with inhibited acid.

Q. What did they say about the difference between inhibited acid and uninhibited acid? A. I don't remember.

Q. I mean, the Penn Salt Company? A. I don't remember.

Q. They said that they did not want to bother with it, didn't they? A. I don't remember what they did say.

Q. Was there anything in writing about this? A. I don't believe there was, no.

Q. The only particular incident that you can tell us specifically about, where you had any pitted pipe, or anything of that kind, is this one Flannigan well, is it? A. The McClanahan well.

Q. That is the only one that you saw? A. That is the only one that I saw, yes.

Q. Do you know for a fact that your company ever paid any money to anybody to reimburse it for any damage to any pipe? A. It seems to me that we paid for some tubing over in Muskegon.

Q. How much tubing? A. I don't know.

Q. You don't know? A. That I couldn't say.

Q. Who to? A. I don't know.

Q. When? A. That was in the summer of 1932.

Q. When in the summer? A. Well, I would not say.

Q. You say that it seems to you? A. Yes.

Q. Are you sure of this thing, or are you just— A. (Interrupting): You mean, am I positive about it?

Q. Yes. A. No, I am not positive.

Q. You cannot give us the name of the company? A. No.

Q. Or the date? A. No.

Q. Or the amount that you paid out? A. No.

Q. Or the amount of the tubing that was involved? A. No.

Q. Did you ever have any complaint about your Penn Salt acid injuring the pipe, or pitting the pipe anywhere except down at the bottom of the pipe, and around the outside? A. Oh, you mean up at the top of the pipe, or something like that?

Q. Yes. A. No, not to my knowledge.

Q. No complaints at the top, or in the inside of the pipe? A. Not to my knowledge, no.

Q. The only complaints were around the outside, at the bottom, is that right? A. I believe that is right.

The Court: Can you tell me about how many wells your outfit—whether it was a copartnership or corporation—treated altogether? A. About, I would say perhaps 100.

The Court: Can you tell me where those were located as nearly as you can, as to how they would be divided, as to location? A. In Michigan? You want the places in Michigan?

The Court: Well, yes, divide them as to Michigan, Muskegon, and over here in this field, as well as you can. You think all told, one hundred, and you don't make these exact, as I understand you. A. No.

The Court: That is your best estimate? A. Yes, sir.

The Court: Now, in the same way, as near as you can, tell me what fields those wells were located in. A. Mt. Pleasant field—Greendale field.

The Court: About how many would you say out of the one hundred all told, there? A. Oh, I would say maybe twenty-five.

The Court: Now, the next field? A. Muskegon.

The Court: How many would you say? A. Why, I would say maybe twenty, twenty-five.

The Court: And what other fields? A. Then we treated in Breckenridge, Texas.

The Court: How many do you think at Breckenridge, Texas? A. Maybe fifteen or twenty.

The Court: And what other fields in between? A. We treated in Louisiana I would say probably about the same amount.

The Court: Fifteen or twenty. A. I couldn't give you exact on those, Your Honor.

The Court: Any other fields? A. We treated two wells, I think, in Oklahoma.

The Court: Any other place? A. No, I believe that is all. That might vary one way or the other on those.

The Court: Well, your maximum adds up to 92. Taking your estimates it would be Mr. Pleasant 25, Muskegon 25, Breckenridge, Texas, 20, and Louisiana 20, and Oklahoma 2. That would add up on that basis to 92. A. Possibly you might have more.

The Court: Well, did some of the members of your organization go down to these distant places? A. To Texas and Oklahoma, you mean? Yes, Mr. Dougherty was down there and I was down there.

The Court: Now, how many of those would you—as near as you can tell me, were with acid and how many by inhibited acid? How can we make that split? A. I couldn't say, Your Honor. We might have treated more wells than one hundred wells, I would say.

The Court: You think probably if you was going to raise those, I have only got up to 92 was the highest estimate. Which would you raise, you think, more? A. We treated more with inhibited acid than we did with the other acid.

The Court: How many do you think you treated with the raw acid? A. Why, maybe 20, 25.

The Court: Well, then, you think the balance of them would be inhibited? A. Yes.

The Court: And as nearly as you can tell, was it a clear cut shut off when you got through with inhibited—or the raw acid and you went to using inhibited, was it cut off at a certain time or was there a period when you were using both, do you think? A. It seems to me we ran out of acid once when they were shipping it to us out of Cleveland in tank cars, and it seems to me we went down maybe once or twice, when we were out of acid, and got another lot of acid.

The Court: After quitting using raw acid then you went over to the inhibited and you found some little difficulty about getting inhibited, you think you went back to the raw acid? A. I think we used a load or two, yes.

The Court: Well, now, when do you think it was that you—well, you think you have shown me the bills for the first inhibited acid you bought here?

Mr. Conner: I have the actual cancelled checks in payment for acid from both Penn Salt and Grasselli, and I have old bills and invoices, and if you like I will re-examine this witness to see what he knows about them, but the papers I have did not come from his files.

The Court: What is the earliest invoice you have got, or is it a check, for the first acid?

Mr. Conner: The earliest check I have here, and I don't know that that is complete, I will have to find out from the witness, the earliest check I have here in payment to the Penn Salt Manufacturing Company is August 9, 1932.

The Court: That is for raw acid, I take it?

Mr. Conner: Well, the earliest check I have here for payment to Grasselli is September 19, 1932.

The Court: That is the one you spoke about. All right. And then you think after that you still bought some more raw acid? A. I believe we did, Your Honor, yes.

The Court: Can you tell me somewhere near when that was? A. Maybe in September or something like that. I wouldn't try to tell you the exact date.

The Court: Well, was it a long while after you had

begun the use of inhibited acid? A. Not such an awful long while.

The Court: Now, can you tell me the fields in which you used raw acid in that way? A. We used raw acid in the Muskegon field and in the Mount Pleasant field (Michigan).

The Court: Any other field? A. No.

REDIRECT EXAMINATION

By Mr. Conner:

Q. Did you use the acid from the Penn Salt any place other than just in Michigan? A. No. That is all.

The Court: And he has told us the two fields and he used it in both, Mount Pleasant and over in Muskegon.

Mr. Conner: Now, when you purchased acid from the Penn Salt Company, do you remember any particular incident relative to trying to store that acid? A. Yes. We brought it in. You see, when we brought the acid up it was quite strong. It was too strong to use in the wells. And we brought it up and put it in some vinegar barrels and it slopped over or something and ate the hoops off the barrels and ran out on the cement floor.

Q. Ate the metal hoops off the barrels? A. Yes.

Q. Will you tell me what kind of tanks you and your partners used in transporting acid out to the fields here in Michigan after you started purchasing Grasselli Duclean acid? A. We used some steel tanks we had made by the Wicks Boiler at Saginaw.

Q. What if any trouble did you have with respect to the acid eating up those tanks? A. We didn't lose any tanks.

The Court: Now, you used inhibited acid, of course, for that? A. When we was using steel tanks?

The Court: Yes. A. From Wicks?

The Court: Yes. Had you heard that there was a patent that had been issued that told you that you could transport in steel tanks if you had it inhibited? A. No. It seems to me that DuPont's man told us it would be all right for us to use steel tanks for the inhibited acid.

Mr. Owen: I stated before the recess that I thought I might throw some light on where Mr. Blum got his information about these early acid treatments. It is in the form of a number of items published in the Oil City Derrick, during the period that Van Dyke and Frasch were carrying on their operations near Lima. The Oil City Derrick, I understand, was the leading publication in the oil industry way back at that early date, and it later became the Oil and Gas Journal, which is now one of the leading publications in that field.

The Court: The publication we did have (PX-93), that one article was in what?

Mr. Owen: That was in the Oil City Derrick.

The Court: I take it that we are pretty safe in saying that it had its origin with Van Dyke; he had this in his file, and then he and somebody they got to do it wrote it up.

Mr. Owen: It was prepared for this purpose, I understand.

The Court: Yes.

Mr. Owen: I offer as PX-142 a Carnegie Library Card showing what files of the Oil City Derrick are contained in that library; also as PX-143 to 149, inclusive, photostatic copies of portions of the issues of that publication for October 28, 1895, November 9, 1895, January 15, 1896, February 20, 1896, February 22, 1896, March 26, 1896, and August 10, 1897, respectively.

The Court: Are there other trade publications covering this subject that have not been searched? You have looked in the most likely places and the best publications, probably, to look, but sometimes they are not so conspicuous a publication that will carry it.

Mr. Lyon: We haven't found any other publication of those dates that offered any promise of disclosing any articles about this thing.

Mr. Conner: The Oil City Derrick was published right up in Oil City, Pennsylvania, right in the heart of the original Pennsylvania wells, very close to where the original Drake well came in.

The Court: Now, when you came to look for articles on the subject we are interested in, did you just search those newspapers, one copy after another?

Mr. Owen: Yes, that is true, Your Honor.

Mr. Lyon: Had to read every issue to see if we could find something.

CHARLES I. DOUGHERTY,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

I live at Mt. Pleasant, Michigan, and have lived there for 11 years. I am in the oil well drilling and contracting business, have been in that business off and on for about 30 years and have operated in the states of New York, Pennsylvania, Ohio, Michigan and Texas. At present I am still in the same business and am operating in Michigan.

I know Edgar Lee and was connected with him in a business venture which had to do with treating oil wells with acid for the purpose of increasing their production. I had a partner in the contracting business named Fred Markey, and the two of us, with Edgar Lee, formed a company, which was called the Oil Maker Acid Company. This was about the middle of June, 1932, and we incorporated under Michigan law shortly after we formed the company. We rendered a service of putting acid in oil wells to increase their production. We operated in Michigan from about the latter part of June, 1932, up until, I believe, the latter part of 1933. I am not just positive of that. We operated in Michigan, Texas and Louisiana. I would say that we probably treated with acid during the time we were in business about 250 wells. I have records with me which would enable me to more correctly ascertain the number of wells that we treated. I think I have all the records here, but I do not know. There were a couple of cases full of them, but I didn't bring them all. We kept a separate record for each well that we treated.

Our intention was to make some money, and the service that we rendered in practically all cases was an attempt to increase production of an oil well. We were a service company treating oil wells with acid to increase production and to make money.

At first we purchased the acid from the Pennsylvania Salt Manufacturing Company of Wyandotte, Michigan. That is just out of Detroit. We purchased acid from these people from the latter part of June through July and I believe somewhat in September of 1932. I am not positive whether we purchased any acid from these people in August, 1932, or not.

I have examined a set of checks commencing with the date of August 9, 1932, and ending with the date of October 18, 1932, all of which are made "pay to the order of Pennsylvania Salt Company" and signed by the Oil Maker Company by Grace Farmer in some instances and in other instances signed Oil Maker Company by Edgar Lee, and I identify these as checks that were issued by the Oil Maker Company, in payment for purchases of acid from the Pennsylvania Salt Manufacturing Company.

At this point the checks paid to the Pennsylvania Salt Maufacturing Company between the period August 9, 1932, and October 18, 1932, were offered and received in evidence as PX-205.

The Witness Continuing: I will now read the number, date, and amount of each of these checks constituting PX-205.

Check #6	August 9, 1932	Amount $35.61
Check #8	August 15, 1932	Amount $35.61
Check #9	August 16, 1932	Amount $53.76
Check #10	August 17, 1932	Amount $53.76
Check #11	August 18, 1932	Amount $35.61
Check #12	August 18, 1932	Amount $53.76
Check #13	August 18, 1932	Amount $18.15
Check #14	August 20, 1932	Amount $53.76
Check #15	August 20, 1932	Amount $35.61
Check #17	August 24, 1932	Amount $54.76
Check #21	August 26, 1932	Amount $35.61
Check #22	August 27, 1932	Amount $71.22
Check #25	August 31, 1932	Amount $68.88
Check #31	Sept. 1, 1932	Amount $68.88
Check #32	Sept. 3, 1932	Amount $39.26

Check #33	Sept. 8, 1932	Amount	$53.14
Check #34	Sept. 9, 1932	Amount	$93.87
Check #35	Sept. 12, 1932	Amount	$93.87
Check #42	Sept. 16, 1932	Amount	$53.14
Check #59	Sept. 30, 1932	Amount	$35.42
Check #73	October 17, 1932	Amount	$88.56
Check #74	October 18, 1932	Amount	$88.56

All of the checks, invoices, or other papers or letters that I will be talking about here today came from our files at Mt. Pleasant, Michigan. I have had them in my possession since this company ceased to operate.

The invoice of the Pennsylvania Salt Manufacturing Company, dated July 25, made out to the Oil Maker Company, for 530 gallons of muriatic, of 18° Baumé, shows that we bought and paid for that amount of acid from this company. This invoice was probably given to a truck driver. This acid was bought and paid for by our company, by our check Number 8 dated August 15, 1932, that check being in the amount of $35.61.

I have examined certain invoices from the Pennsylvania Salt Manufacturing Company to either E. J. Lee Company or the Oil Makers Company, these being invoices #199, dated August 5, 1932; #200, dated August 6, 1932; #203, dated August 10, 1932; #204, dated August 12, 1932; #208, dated August 16, 1932; #209, dated August 16, 1932; #213 dated August 27, 1932; #212, dated August 19, 1932; #218, dated August 27, 1932; #220, dated August 31, 1932; an invoice dated September 17, 1932, and invoices #320, dated October 17, 1932 and #231, dated October 18, 1932, and all of these invoices show materials that were purchased from the Pennsylvania Salt Manufacturing Company by us, and the materials purchased were muriatic acid.

I have examined the checks that my company paid to the Pennsylvania Salt Manufacturing Company, and the invoices that the Pennsylvania Salt Manufacturing Company issued to my company, and I find that the invoices bear a check number, which checks I have in hand, and

which invoice I have in hand, to show that certain checks were issued in payment of these invoices.

The Court: You are saying, witness, that for every invoice that you have there was a check, and you did pay for it? A. Yes.

The Court: And you say that for every check you wrote there was an invoice, and the acid was delivered to you?

Mr. Wiles: The witness said he paid for the first one in cash money. A. Yes, the first few trips.

The Court: You are saying that every time you find an invoice, that it got paid, and that every time there is a check, that they got it, and they didn't get paid twice? A. Yes.

The Court: I am satisfied with that kind of proof for this kind of thing. It seems very complete for the purpose for which you introduce it.

At this point the invoices from the Pennsylvania Salt Manufacturing Company commencing with the date July 24, 1932, and continuing to invoice dated October 18, 1932, and issued to the Oil Maker Company or Edgar Lee, were offered and received in evidence as PX-206.

The Witness: I and my partners in the Oil Makers Company were in the business of acid treating oil wells in Michigan, and we started in this business about June 22, 1932. When we first started in this business we purchased our hydrochloric acid from the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan, but I had bought one load of acid from The Dow Chemical Company before purchasing acid from the Pennsylvania Salt Manufacturing Company, and sent that acid to Ohio where I used it on some property I owned down there. But this was before the Oil Maker Company was formed, and it was in the early part of June, probably the 1st of June, 1932. I have no record of this purchase of acid in my book, I probably have it in some other records. I do not now recall in what type of container I received the acid when I purchased it from The Dow Chemical Company. I do not recall whether it was a

Dow truck that took it for us, or what it was. The acid was taken to Wooster, Ohio, where it was used in one of the Dougherty Brothers wells.

While we were in this business of treating wells with acid, we treated for practically all of the oil companies in Michigan. We treated wells for the Columbia Oil & Gas Company, Gordon Oil Company, McClanahan Oil & Gas Company, Stork Oil Company, Malcolm Oil Company, The Moline Oil Company, and the Witt and Nelson Oil Company.

I knew that the acid that I purchased from the Pennsylvania Salt Manufacturing Company was not inhibited. I knew this because I made a trip down to Wyandotte, Michigan, to see about this acid, and these people had no inhibitor. It was the acid I purchased from the Pennsylvania Salt Manufacturing Company that I was using here in Michigan in treating wells.

As to the invoices from the Pennsylvania Salt Manufacturing Company to the Oil Makers, the only ones that I have here which reflect the purchase of acid from this company after the last day of August, 1932, are the invoices dated September 17, October 17 and October 18, 1932, each for 1000 gallons of acid, and each costing $88.56.

I have examined a number of checks all made payable to the order of the Grasselli Chemical Company, these checks commencing on the date of September 19, 1932, and ending with the date of April 15, 1933. I have examined these checks and they reflect the purchase of materials from the Grasselli Chemical Company on or about some time near the date of the checks and show that the Oil Maker Company or the Edgar Lee Company bought certain materials from the Grasselli Chemical Company.

These checks are as follows:

Check #46	September 19, 1932	Amount	$475.00
Check #47	September 20, 1932	Amount	$ 71.75
Check #48	September 23, 1932	Amount	$ 71.58
Check #49	September 20, 1932	Amount	$ 35.76
Check #60	September 29, 1932	Amount	$475.00

Check #72	October 11, 1932	Amount	$435.00
Check #76	October 25, 1932	Amount	$500.00
Check #86	November 9, 1932	Amount	$500.00
Check #89	November 17, 1932	Amount	$441.00
Check #8	January 10, 1933	Amount	$400.00
Check #24	January 26, 1933	Amount	$300.00
Check #25	January 28, 1933	Amount	$ 90.62
Check #33	March 29, 1933	Amount	$200.00
Check #38	March 31, 1933	Amount	$ 50.00
Check #42	April 10, 1933	Amount	$ 50.00
Check #44	April 15, 1933	Amount	$ 50.00

At this point the above-referred to checks were offered and received in evidence as PX-207.

I have examined certain invoices from the Grasselli Chemical Company, being invoice No. 30032, dated September 22, 1932; No. 90631, dated September 29, 1932; and No. 91183, dated October 17, 1932, these being invoices issued to the Oil Makers Company from the Grasselli Chemical Company, and all of these invoices show that the Grasselli Chemical Company sold to the Oil Makers Company Duclean No. 2 acid. On each of these invoices from Grasselli to the Oil Makers Company, the material sold is identified as being Duclean acid.

At this point the above-referred to invoices Nos. 90631, 91183 and 30032 were offered and received in evidence as PX-208.

At this point there was read in evidence the following portion of a deposition of

ARTHUR S. WEYGANDT,

taken by defendant in this cause at Cleveland, Ohio, on Tuesday, April 22, 1941:

"Q. Will you give your full name, please? A. Arthur S. Weygandt.

"Q. Your address? A. 1052 Roanoke Road, Cleveland Heights.

"Q. You are employed by the Grasselli Chemical Division of duPont? A. That is right.

"Q. What is your position? A. Manager of the General Research Section of the Chemical Division.

"Q. How long have you been with duPont or the Grasselli Division of duPont? A. I was with Grasselli from 1925, and it was taken over by duPont in 1929 I think.

"Q. At any rate, during 1932 you were employed by this company? A. That's right.

"Q. Are you able to state what the general nature of that No. 2 pickling compound was? A. No. 2 pickling compound, which we also term 'Duclean No. 2,' is an inhibited muriatic acid.

"Q. I ask the witness to state what his instructions were or what instructions were issued from this laboratory as to what agents should go into No. 2 pickling compound? A. The instructions from this laboratory called for the addition of a small amount of the complex organic compound which was the active inhibiting agent to commercial muriatic acid."

CHARLES I. DOUGHERTY (Continued)

The Witness: The Duclean No. 2 acid that we purchased from the Grasselli Chemical Company we hauled in an iron tank. When we purchased acid from the Pennsylvania Salt Manufacturing Company we hauled the acid in wooden cypress tanks. The wooden tanks were about 1000 or 1100 gallons capacity. When we were purchasing acid from the Pennsylvania Salt Manufacturing Company we used wooden tanks. When we were purchasing and using acid from the Grasselli Chemical Company we used steel tanks all of the time, not all of the time because we had two of these wooden tanks which were left over. We sent the steel tanks into Texas and Louisiana. We had two wooden tanks when we were using the Pennsylvania Salt Manufacturing Company's acid, and we had these tanks left over, and we also used steel tanks as well as wooden tanks when we were buying the acid from the Grasselli Chemical Company. When we were buying acid from the Pennsylvania Salt Manufacturing Company we sent an iron tank down there to get the acid. We were just going into this business and had contracted to do some work. We sent the trucks down to the Pennsylvania-Salt Manufacturing Company and they refused to load them.

The amount of money indicated on the checks Nos. 6, 8 and 9 made payable to the Pennsylvania Salt Manufacturing Company on the dates of August 9, August 15 and August 16, 1932, respectively, do not indicate that these amounts of money were used to purchase acid for use in a single treatment. We would send a truck down to the Pennsylvania Salt Manufacturing Company and bring back a load, and then we would take out some of this acid and put in water to replace it. I think we brought back 1100 gallons. The tanks held about 1100 gallons. We would reduce it in half, that is half water, using about 550 gallons of acid.

The big majority of the acid treatments that we were making took about 500 gallons of acid. The acid that we

brought back from the Pennsylvania Salt Manufacturing Company was not diluted acid, but 30 per cent strength acid, so we would bring back 1000 gallons of that type of acid and dilute it down to 15 per cent strength acid, which would make 2000 gallons of diluted acid. We put about 500 gallons of diluted acid in the majority of the wells we were treating. So that out of 1000 gallons of acid diluted down to give 2000 gallons of diluted acid, we would treat about four wells using 500 gallons of diluted acid in each well.

Our company was treating wells here in Michigan during the months of July and August with acid that came from the Pennsylvania Salt Manufacturing Company. During the months of September and October of 1932, according to my checks and invoices, I also bought some acid at least from the Pennsylvania Salt Manufacturing Company. Also at that time, namely some time in September, according to my checks and invoices, I started to buy the Duclean No. 2-A inhibited hydrochloric acid from the Grasselli Chemical Company.

When we were using the acid from the Pennsylvania Salt Company we had some complaints of damages from the oil companies and operators relative to damage that the acid did to the well owners' equipment or tubing. We ruined a string of tubing for the Gordon Oil Company. That was very near a dry hole, and a hard type of formation to treat. I know that I was out there that night and we were about 24 hours putting the acid into the well. We would just run the pumps about 5 minutes at a time and got up to 1000 pressure and that was all that we wanted to put on the tubing, all of the pressure we wanted to put on. The formation was not taking the acid. In doing this and putting a shot of acid into the well, and that acid was pretty strong as it was, it ate the threads out in between the collars on the string of tubing and ruined the work. We did make a well out of this well, but we could not run the rods back into the well hole. I made a settlement for this damage with Howard Atha, who was president and

general manager of the Gordon Oil Company. Of course, the tubing was all right for line pipe afterwards. We allowed the Gordon Oil Company 5 cents a foot on a new string of tubing, but he used this old pipe for line pipe, that is for gas lines and oil lines on the surface of the ground. I actually saw this tubing which Mr. Gordon complained about. My recollection at this late date is that the threads of the tubing were eaten out in between the joints in the string of tubing. The threads would not screw together. The threads were all eaten out at each end, and that ruined the string of pipe.

In making an acid treatment to an oil well most damage is apt to appear at the bottom of the hole, because the acid is in contact with that part of the pipe longer, and also, even though the well is full of oil, the acid may contact the outside of the tubing. Some of the acid gets on the outside and gets on the collar and that does damage, while in any string of pipe, whether it is acid or anything else, the weak joint at the top is the worst. The weak joint of pipe on top of the string is the most dangerous, and the least dangerous weak joint would be the joint clear at the bottom of the well. This is because the top joint has to carry all of the weight below it. You lose less pipe if you lose it off the bottom joint than if you drop it off the top joint.

I have here a bill, dated September 30, 1932, made out on the letterhead of the Gordon Oil Company to Charles Dougherty, 502 S. Main Street, Mt. Pleasant, Michigan, reading "Damage to 2" tubing during acidizing of Taulker No. 2, 350 feet, September 17, 1932, at 5 cents a foot" and over at the side the bill says, "$175.00." This is a bill that the Gordon Oil Company sent to me. I paid the amount of $175.00 to the Gordon Oil Company and have a check to show that payment. This payment was made in settlement for damage done to the tubing of the Gordon Oil Company's Taulker No. 2 well. The check is dated October 10, 1932.

At this point the bill from the Gordon Oil Company

and the check in payment thereof were offered and received in evidence as PX-209 and PX-210.

The Witness: While we were in the business of treating oil wells we had other instances where complaints were received from the oil people alleging that we had damaged their equipment as a result of acidizing. We had a compaint from the Moline Investment Company of Muskegon, Michigan. We ruined quite a little bit of tubing for these people and I think I settled with Mr. Wolmer, who is here today, for $67.00. I do not recall any trouble of a similar nature with Nelson and Witt. I have examined a check made to the order of Nelson and Witt, dated September 23, 1932, being check No. 51 of the Oil Maker Company signed by Grace Farmer. The check is in the amount of $67.09. I have also examined a ledger sheet of the Oil Maker Company, on which appears an item under the date September 23, 1932, reading "Nelson and Witt tubing and labor, check No. 51, credit of $67.09," but I do not recall that these items reflect any trouble we had with Nelson and Witt. Nelson and Witt were in the business of oil producers. We were treating wells for these people, but this must be for something else (witness looking at ledger sheet) because I do not recall any damage that we caused to any of their wells. I knew that they were real pleased with our work.

I have examined page 3 of the ledger book of the Oil Maker Company and thereon, under the heading, Stork Oil Company, dated October 31, 1932, there occurs an item in pencil notation "Pipe damage amount $121.50." I know that my partner, Fred Markey, made a settlement with the Stork Oil Company. He was a partner with me in the Oil Makers Acid Company.

I have re-examined the check dated September 23, 1932, being the Oil Maker Company's check No. 51, payable to Nelson and Witt in the amount of $67.09 and have considered the ledger sheet of the Oil Maker Company and the items therein under the date of July 23, 1932. The ledger sheet shows moneys paid out by the Oil Maker Company, and on the ledger sheet under the heading "Explanation" appears the item dated September 23, 1932, under the head-

ing Nelson and Witt, and under the heading "Account Affected" it says tubing and labor. And then the ledger sheet says check No. 51, which corresponds to the check I have. The amount of the check, according to the balance on the ledger sheet, is $67.09. This amount in the ledger sheet corresponds to the amount appearing on the check I have in my hand. We would not have purchased any tubing from Nelson and Witt. I do not recall why our company would have paid this check to Nelson and Witt, nor what the check would be in payment for. I do not recall that we damaged the well for Nelson and Witt. I was not over there very much. Mr. Markey was there most of the time. I do not know what this check was in payment for.

At this point the Oil Makers Company check No. 51 to Nelson and Witt dated September 23, 1932, was offered and received in evidence as PX-211 and the ledger sheet of the Oil Makers Company was offered and received in evidence as PX-212.

There were other oil companies for whom we made acid treatments to wells and from whom we had complaints as a result of using hydrochloric acid in their wells. We had complaints from the Malcolm Oil Company. We had a complaint from the Stork Oil Company and we made a settlement with them. The settlements that we made with these oil companies were not always made by way of a cash payment. On different occasions we gave them a free treatment of acid, that is we treated a well for them for nothing.

We always used the same kind of acid in giving these free treatments by way of settlement. Sometimes the settlement was by way of treating the wells at half the price, or whatever it was. In other words, the operators of the oil wells, and the oil companies, considered that our treatment of their wells with acid did the wells some good, and they were willing to take another dose of the same acid.

I have examined the statements of the Malcolm Oil Company and the G-Lee-P Company. The Malcolm Oil Company's statements bearing the dates July 24 and 29 and August 4 and 11 and October 7 and 11, 1932, and the

G-Lee-P Oil Company's statements bearing the dates of August 7 and 13 and September 13, 1932. And each of these statements has appearing opposite it the notation "no charge." We obviously gave these companies a free treatment, but I do not remember giving the Malcolm Oil Company that free treatment.

The Court: What is the earliest date of a complaint that you can fix with certainty out of all of those? A. Well, I can't say. It would be around the 1st of July.

The Court: I don't find anything that fixes a date earlier than October, or at least late in September now, but if there is anything here I would like to have my attention called to it. A. Well, our complaints didn't come in until they put the wells to pumping, see?

The Court: But that is what I was thinking. I was asking when you got these complaints. They seemed to come in, as I get it, early in September or early in October or late in September, quite a bunch. A. Well, I think that would be about right. You see, the wells would flow after an acid treatment, they started off to flow, most of these wells.

The Court: You were treating them along through the summer there. I don't want to get a wrong conclusion about it. A. They would never discover that there was anything wrong with the tubing until they wanted to put them to pumping, with the walking bar.

The Court: I will let you know, all of you, what is running through my mind. It is a mean thought, maybe, that I have, but I got to watch for all of these things. I was wondering if those letters sent out by Dow calling attention to the patent, whether that had anything to do with it, that they had just got, and claiming to the oil treaters like you—I haven't had any proper proof of it yet, but rather hearsay proof—but they went to the people that had the wells at the same time, and I can just imagine every fellow that would go out and look at his old pipe would maybe stick you for an oil pipe that would be pretty near wore out when you treated it. I am wondering, did

you know of these things? A. That wouldn't be true, because they don't have that kind of men in the oil business.

The Court: I have had some here that were pretty—one side must have been wrong in some of my cases. A. In one instance I just mentioned, the Gordon Oil Company, under Atha, well, he took me out of—this was all new tubing when it was run in at that time.

The Court: That is one thing I wanted to know about. A. Oh, yes; that field was all equipped with new material, practically all new tubing; they had run new tubing through.

Practically all of the oil producers in the Michigan field used new tubing, because that is one of the main strings of pipe, and they were getting nice wells. They had no tubing that they had used over and over. They do use the casing pipe over and over if the well plays out. These wells that we were treating in Michigan were new wells. Practically all of them were new wells and had only been drilled in for a short time. These wells were down to small amounts of production. Some wells that we treated were dry holes and we made oil wells out of them. They had not been producing before we treated them.

You do not get enough wells so that you put a tubing down in pretty nearly every one you drill. I haven't found it so in the last few years, as I haven't drilled an oil well in that time. They have all been dry holes.

The tubing of the Gordon Oil Company's well was a new string of tubing. It was in for some time after the treatment, because at first the well flowed. The well started to flow and they thought they were not getting as much oil as they would if they put the well to pumping, so they ran the rods into the well and put the well to pumping, but they could not make it pump. Then they pulled the tubing and finally the working barrel. I know that this was a new string of tubing because I saw it and you can tell by the looks of it. I went out to the well and looked at the tubing and you could still see the paint marks on it, the figures of the length of the tubing, etc. I saw the tubing just a few days, two or three days, before we made the settle-

ment. This was a new well and had only been in for about two or three days before we treated it. It was practically a dry hole and they had to haul oil out to treat this well with. The well didn't make any oil and they didn't get any oil out of this well. On this particular string of well tubing I saw the effects of the acid on the tubing in between the threads and in between the joints. The tubing had been unjointed and the last few joints on the bottom of the tubing were pitted on the inside.

The Court: The same as the other witness told about? The same well? A. No, he didn't see this well. The working barrel in an oil well is turned out in the inside, turned a perfect size. It was badly pitted. It wouldn't be right to put it back in.

The Court: How much did you see it had been pitted? A. Oh, just so it was rough on the inside.

Q. How many feet? A. Of the working barrel?

The Court: How many feet that you saw? A. Just the bottom four or five joints.

The Court: How long was that? A. About 28. Varies from 22 to 28 feet per joint.

The Court: It would come within 100 feet? A. Yes, it would.

The Court: You say that it was pitted on the outside? A. No, I say, the tubing is a little bit rough anyway there.

The Court: Do you think that it would pit on the outside? A. It would,—if there was acid on it, you mean?

The well was acidized by putting the acid down the inside of the tubing, and to prevent the acid from coming right up on the outside of the tubing, the well hole was filled with oil outside of the tubing, then pressure was put on the oil. I cannot say how far up on the outside of the tubing the acid came. We carried a pressure on the outside of the tubing with the hole filled with oil to keep the acid from coming up on the outside of the tubing and to shove the acid back into the formation. The acid will probably come up around the outside of the tubing for a little ways, probably to the extent of three or four joints of

tubing, that would be about 100 feet, probably. I think that the acid could come up 100 feet on the outside of the tubing. I know that the acid had come up 100 feet on the outside from the way that it was eaten around the joints. The tubing is a little bit rough on the outside anyway, that is it is rougher on the outside than on the inside. This would not prevent corrosion. The tubing was probably corroded on the outside, but we didn't pay any attention to that. It is naturally rougher anyway. It is not a smooth surface. It would not be easy to tell whether it had been pitted on the outside from acid or not. On this tubing of the Gordon Oil Company the threads of the tubing had been eaten, and that was the only real serious damage. The threads of this tubing were pitted and that was the big thing, that was the serious thing with these threads.

The Court: I am going to want in each case where there is a complaint, the date when the well was treated—that is, if I can get it—the date when the well was treated, and the date when the complaint was made; as well as the date when they settled it, or did something, or something happened about it, if I can get it. I just thought that might help you as you are going along, rather than waiting until after the witness was excused, but I did want those three things.

Mr. Conner: I hope that Your Honor will not hold us to such exact proofs, in that sequence, because this was a small company, and they have been out of business for eight or nine years.

The Court: I am not, but I am just letting you know that I would like to have that, I am letting you know that as you go along, so if you see a place to put it in, you may.

Mr. Conner: We will try to do that.

The Court: I thought it was better to tell you now than to wait until your witness had gone, and then say what I would like to have you do.

The Witness: I have examined the entries appearing on page 3 of our ledger book under the heading of Stork Oil Company. We had some trouble with respect to cor-

roding the tubing of the Stork Oil Company and we made a settlement, but I do not recall the details. The notations under the Stork Oil Company appearing in our ledger book says "October 31, 1932, pipe damaged, $121.50. This appears on page 3 of the ledger book under the heading of the Stork Oil Company.

On page 5 of our ledger book, under the heading of Columbia Oil & Gas Company, I find an entry under the date of September 20, 1932, and an entry for October 17, 1932, and opposite each of those dates I find a notation "no charge."

The date appearing in this book opposite the Stork Oil Company to my mind does not indicate the date when we made the adjustment and came to an agreement, or the date when damage was done to an oil well belonging to this company. The dates here given are the dates that we gave a free treatment to these companies. We gave a free treatment for some damage that had been done previously. There is nothing in this ledger book to indicate the well the free treatment was given to, or what well had been previously damaged. It might be that the free treatment was given to the same well previously damaged. The entry says that 1000 gallons of acid was used in the free treatment. The entry for October 26, 1932, says that 1000 gallons of acid was used, and that 1000 gallons of acid was used in the treatments for September 20 and October 17.

On page 31 of this ledger book, under the account carried for Cliff Warner, I find the notation "No charge, for $130.00" and a second notation "No charge" appearing under the date of October 8, 1932. There is no date for the first notation. This ledger book has been in my files at Mt. Pleasant, Michigan, in the office of Dougherty and Markey. It has been in my possession. I do not know who made these entries. One of the bookkeepers, I think, made them when we started keeping these books at Mr. Lee's office in Midland. The books were there when we first started in business.

This ledger book shows the extent, so far as it goes, of the business done by the Oil Makers.

At this point the ledger book of the Oil Makers Company, was offered and received in evidence as PX-213.

The Witness: A copy of a statement made to the G-Lee-P Oil Company under the date of September 11, 1932, carried the notation "One shot, no charge." This is a statement made to the G-Lee-P Company by the Oil Makers Company or a copy of a statement. It does not, however, have on it the name of the Oil Makers Company, but I have no doubt but what it is a copy of the statement rendered to the G-Lee-P Company.

At this point the statement rendered to the G-Lee-P Oil Company was offered and received in evidence as PX-214.

The Witness: This is not a bill for damages. It is a statement of accounts due with the notation "No charge" on it, which was rendered to the G-Lee-P Oil Company, which operates in the Greendale field of Michigan.

Another statement is made out to R. C. Malcolm Oil. This statement shows accounts due the Oil Makers Company, and opposite the dates of October 7 and October 11 appear the notation "One shot" followed by the notation "No charge."

At this point the statement to R. C. Malcolm was offered and received in evidence as PX-215.

There is no date showing the year on this statement to R. C. Malcolm but I am sure that it would be 1932 or 1933. We continued in business about a year, a little over a year. We always managed to get a check for the treatment we had already made, and then when making a settlement we gave a free treatment. I do not remember when it was the other way around. There were several times when we had to take money out of other of our concerns to keep the Oil Makers Company going, and put it over into this venture. Mr. Markey and I were in the oil business and Mr. Lee was in the business with us and he used his trucks to haul the acid. So we could take money out of Dougherty and Markey and nobody but ourselves was involved.

I received a notice from The Dow Chemical Company

calling attention to their patent No. 1,877,504. This notice of this patent was received in the form of a letter. I have the letter here before me and it is marked PX-199, and the letter is dated September 23, 1932.

My associates did some acid work in Texas. Mr. Edgar Lee was doing that work in Texas. I treated the first well that was treated in Texas for Pitzer and West. I did this work myself for Pitzer and West, who later formed the Chemical Process Company. I treated the first well that was treated in Texas for Pitzer and West. I made this treatment in the latter part of June, 1932, and I used hydrochloric acid which came out from Fort Worth, from a chemical company in Fort Worth, but I cannot recall the name of the company now. This was hydrochloric acid and it was raw hydrochloric acid.

CROSS EXAMINATION

I cannot recall or give you the approximate date of the last acid treatment that was performed by our company before we went out of business. The last treatment was in Louisiana and Mr. Lee was there at that time, and I wasn't paying much attention to it. I cannot give you the date of the last treatment that we made in Michigan, nor can I tell you the name of the well that we last treated in Michigan, we treated so many of them. I would rather think that the last date of a well that we treated in Michigan would appear in our ledger, which is marked PX-213. I am not positive of that. I cannot tell you whether or not our ledger contains a record of each and every treatment that was performed by our company or by our partnership in the State of Michigan. I do not know whether the ledger contains this complete data or not. I did not pay much attention to the book, the ledger.

This company was a side issue with me. I never had occasion to have these books audited or checked, and I could not swear that they were kept correctly. I made no money out of this company called the Oil Makers. I think

that Mr. Markey and I each put in $200.00 and Edgar Lee furnished the truck. Our capital to start was $400.00. I did not get any money back, I lost. I never got any money back out of this venture.

I received no salary and spent a lot of money. I spent quite a lot of money. We did not go through a court in bankruptcy. We got out of business by just paying off our debts. That is all. We did not come out exactly even, we had to take money out of our pockets to get settled up. We each put in $200.00 to start with and I think we had to put in $700.00, if I am not mistaken, to wind up the business. I mean that Dougherty and Markey put in $700.00 to wind up the business. Mr. Markey and myself did not draw a salary, but Mr. Lee drew a salary of $250.00 a month plus expenses, I believe it was something like that.

We were not the first ones in Michigan to offer this acidizing as a service to the oil industry. We were drilling some wells out in the Greendale Pool of Michigan when The Dow Chemical Company and the Pure Oil Company started to experiment on some Pure Oil Company wells using acid. I think The Dow Chemical Company first went into this acidizing business offering this service to the different oil companies. I think The Dow Chemical Company had already gone into this business before we started.

I know the G-Lee-P Oil Company very well. I drilled some wells for them. Mr. Lee, who is here in the court room, is one of that company. The Oil Makers Company acidized the first well for the G-Lee-P Oil Company. I believe that I am mistaken. Upon consideration of the article appearing in the Midland, Michigan, "Midland Reporter" under the date June 9, 1932, reading "Since the commercial use of the acid was decided upon, the G-Lee-P firm has been the first to contract for its use, according to Laurence W. Lee, an official; one well is being treated, while 6 more are to be given acid in an attempt to bolster production." This is not work that the Oil Makers Company did. I believe I am mistaken in stating that the Oil Makers treated the first well for the G-Lee-P Company. I think that the G-Lee-P

Company did have Dow treat the first well up there for them. I am quite sure of that now.

The first time that any representative of The Dow Chemical Company ever talked to me about this subject, or examined my records that I have produced here, was about a week ago Sunday, I believe. First they called me over the telephone two or three nights previous to that, and that was the first time they contacted me. That was the first time I had any communication or any contact of any kind with anybody of the Dow Chemical Company regarding this case.

Mr. Lyon: I am not talking about this case, but I am talking about your experiences in 1932 in acidizing wells? A. Well, we had a lot of discussion, yes, at the time we were treating wells. Do you mean back at that time?

Q. Was there any discussion at that time about these settlements that you made for damages—or, for damage to wells? A. With a Dow official, you mean?

Q. I don't know anything about officials; with anybody in the Dow Company; did you have any discussions with them about it? A. I don't recall. I believe I did get in a discussion with Bob Quinlan. He was with the Dow Chemical Company at that time. That was in Muskegon.

Q. As a matter of fact, Mr. Dougherty, didn't the Dow Company advise you, or some representative of theirs advise you, or your associates, to make some of these settlements? A. Oh, no.

Q. They did not? A. Oh, no.

Q. You didn't discuss it with them at the time? A. We didn't discuss anything with Dow at that time.

The Court: I think you interrupted him. He was about to tell us something about Bob Quinlan and what conversation he had with him. A. That was pertaining to this inhibitor, that we were infringing on the Dow patent.

The Court: When was that? A. That was about in August of 1932.

The Court: Well, what did he say about it? A. That

we were infringing on the Dow patent and we would be shut off, we would be stopped.

The Court: Now, I call your attention to the fact that the Dow patent did not issue until September 13, 1932, and if you are right as to his saying they had the patent I was wondering if it was not later than that, or whether he said they had a patent or going to have. I just call your attention to that, because I can see you are trying to tell me the way it was and all that. A. We heard that right from the start, that Dow had applied for a patent or had one, and was going to stop us from using this acid to treat wells.

The Court: Acid to treat wells? A. Yes.

The Court: Even raw acid? A. Well, yes, even raw acid at that time, because there was an appliance of putting it in under pressure and they had that patented, and all that.

Mr. Lyon: In that connection, so the court will understand the situation while this witness is on the stand, I am going to read a copy of a memorandum dated August 20, 1932, which was produced by the plaintiff in response to our subpoena. This is a memorandum addressed to Mr. L. I. Doan of the Dow Company by Thomas Griswold, Junior, who was one of Dow's patent attorneys. It is dated August 20, 1932, and the subject is "Treating wells."

Reading: "We have had the records in our Dowell acid patent application critically reviewed by Dr. Veazey, with the thought that his experience in patent litigation would be of value, and he has approved the record to date. He makes the following suggestions:

"A. All men in touch with the field to be on the alert to detect infringement, determine who is infringing, who sold the acid, date, what it was to be used for, dates, names, and addresses of all persons acting or having knowledge.

"B. Be on the alert to detect the case of a well injured by the use of acid without the inhibitor. Such an instance would afford very valuable evidence in sustaining the patent. Written reports should be made in all cases to the patent department," and so forth.

Mr. Lyon: Now, I would like to know, what I am trying to find out from the witness is the settlements that were made, of course, the settlements are settlements, and they are not binding on the defendant in this case. The question is how much probative value they have. I want to know if he had any contact with the Dow people at all at that time, and if not how long was it after that before the Dow people came around and asked to examine these records, or learn about these facts? A. They never came to examine our records, and I never talked to any of them pertaining to damage we done on any wells. What right did they have to come and examine our records?

The Court: Whether they talked to people or not, you don't know one way or the other. A. I don't know.

I do not recall whether I talked about this subject or not with anybody before the representatives of The Dow Chemical Company called me up about a week and one-half ago. There is Mr. L. W. Lee, that is one of the officials of The Dow Chemical Company. He is also in this G-Lee-P Oil Company, for whom we contracted and drilled wells. Perhaps it has been talked over between us, but I do not know. Mr. L. W. Lee, one of the officials of the Dow Co., is a brother of Edgar Lee, my partner in the Oil Makers Co. I do not know to what extent Mr. L. W. Lee may have had knowledge of these transactions as to the date they occurred, or since.

Mr. Owen: I would like to call attention to the fact that there is no testimony that Mr. L. W. Lee is an official of the Dow Company. That is not a fact. He is an employee of Dowell, not an official.

The Court: You can state right on the record now what his connection is.

Mr. Conner: Mr. L. W. Lee is an assistant manager for Dowell Incorporated. He is not an officer of Dowell Incorporated and he is not an officer of The Dow Chemical Company. So far as I know he doesn't work for The Dow Chemical Company. He works for Dowell. That is his present connection, but he did formerly work for The Dow Chemical Company.

The Witness: On several occasions I personally negotiated these various settlements resulting in the giving of free jobs and the payment of money on these claims of damage to the well tubing, and on several occasions my partner made these settlements. I think that in each case I was consulted.

After September 1st, 1932, we had some complaints and claims in Texas concerning damage to either equipment or pipe resulting from our acidizing services. Those I do not know anything about. I do not recall any complaints in Oklahoma. We did have some complaints and claims of damages arising from the use of acid which we obtained from the Grasselli Chemical Company. I think there were some claims of damages when we were using this acid. I cannot tell you which of these claims arose from using the Grasselli Chemical Company's acid. I do not remember anything about it. But it is my understanding that we did have some claims arising from the use of the Grasselli acid. I do not remember whether we settled these claims for damages or not. I was in Texas at the time. I do not recall now of any claims that were made against Dowell Incorporated, claiming that the acid sold by them injured the well tubing or pipe.

Q. (By Mr. Lyon): Well, are you sure that there were no claims made against you or your company, or demands for damages or free jobs on the basis of injury to the pipe from the acid that you employed here in Michigan after you started using the Grasselli acid? A. I don't recall that there was any claims.

Q. Do you recall that there was not? A. No, I couldn't say either way.

Q. There may have been? A. There might have been.

The Witness: I believe that the ledger, PX-213, contains a record of each and every acidizing job that I or my associates performed in the State of Michigan after the formation of the Oil Makers Company.

On page 65 of the ledger book, under the account with the Grasselli Company, appears an item dated September

21, 1932, regarding receipt of a car of acid costing $456.57. I do not know whether or not that is the first car of acid received from the Grasselli Chemical Company. It could not be the first car received from the Grasselli Chemical Company. I think that we had acid shipped into Midland from the Grasselli Chemical Company before that.

All of the acid that we received from the Grasselli Chemical Company did not come to us in railroad tank cars; I think that we sent trucks to Cleveland several times to obtain acid. This, I believe, was done in between times when we were short of acid. That is, we would run out of acid and send a truck down, in between times to get acid; the railway cars wouldn't get in so we would send the trucks through.

The Court: It ran up as if you was getting it in Detroit without any difficulty through August and through September, as I glance at it.

Mr. Conner: Yes.

The Court: And then there seems to be a breaking off which made me wonder if you didn't get a few loads by truck, and then maybe your first carload the one you had there, but I don't know. Nobody seems to be able to lead you, so don't let us. A. What is the first check?

The Court (interposing): You are doing pretty good, if he did get that from down there, and had a few truck loads, and then September 19th a carload.

Mr. Owen: Probably if they went over in the truck they paid cash for it, so it wouldn't be by check.

Mr. Lyon: Your Honor please, the witness has asked me for the record of the date of the first check in payment to Grasselli which is recorded here on page 65, which is the Grasselli account. I am calling the witness's attention that the first check is under date of September 19, check 46, $475. A. That is probably the first.

The Court: But maybe not. Don't let me or anybody else, witness, convince you against your best memory about it.

The Witness: It looks as if each customer of the Oil Makers Company and their dealings with this company are

recorded on a separate page of PX-213. This is the first time, I believe, that I have looked over this book. I do not know much about it. In this ledger appear charges made to the customer in the lefthand column, and here is a record of the payments made by the customers in the righthand column. Something has been left off here, I don't know what the reason for that is. According to the record in the ledger, under the heading of the account with the McClanahan Oil & Gas Company, the first acid treatment noted on this account was not the first treatment we made for this company. Page 1 of this book, carrying the account of the McClanahan Oil & Gas Company, shows that according to this book we made fifteen treatments for that company. Practically all of these treatments were successful. I don't recall of any complaints of any kind that we have had from this company. The big majority of these fifteen treatments made by the Oil Makers Company for the McClanahan Oil & Gas Company were made with raw acid.

The next account is that of the Stork Oil Company, for whom the Oil Makers treated three or four wells. I think that all of these acid treatments were successful. I think we made three treatments for them and gave them one free treatment. It would seem that we were using Grasselli acid in treating these wells for the Stork Oil Company.

There is a period in here as to which I am not sure whether we were using the acid from the Pennsylvania Salt Manufacturing Company or from the Grasselli Chemical Company. There is a sort of overlapping period. I want to correct my previous testimony regarding the account of the McClanahan Oil & Gas Company. We treated about fifteen wells, according to this book or record for this company, and the first nine wells that we treated for them we used raw acid from the Pennsylvania Salt Manufacturing Company and the last six wells we treated for them we probably used acid from the Grasselli Chemical Company. The chances are that these last six wells we treated for the McClanahan Oil & Gas Company were treated with Grasselli acid.

According to the ledger, the last treatment for McClanahan was November 30, 1932. I do not recall whether that date is correct or not. According to the record that is correct, but I do not know whether that is the last well we treated for them or not. I do not recall any later treatments than that. We got paid for all of these wells treated for the McClanahan Oil & Gas Company, but we were not particularly careful in keeping our book. I know of my own knowledge that all of these wells we treated for the McClanahan Oil & Gas Company were paid for.

The next account in the ledger book of the Oil Makers Company, PX-213, appears on page 3 of that book and is the account of the Stork Oil Company. We got paid for all of the acid treatments for this company. I do not remember the credit we apparently extended this company on their No. 13 well, involving the item of $121.50. There is a man here that will probably remember it when you get him on the stand. I don't remember it.

The next account appears on page 5 of the ledger book under the heading Columbia Oil & Gas Company.

Q. Will you tell us how many treatments the book shows for this company with what you believe to be the Penn Salt acid, and then how many with the Grasselli acid? A. That would be about the same. About up to the first of November.

The Court: There is October, and I just want to call your attention to it so you will classify it the way you think you ought to there. A. Columbia Oil & Gas. There are about seven or eight shots of Penn Salt.

Q. And how many of those do you believe were successful jobs? A. Columbia Oil & Gas? I am not sure whether we gave them a free shot there.

Practically all of these treatments were successful treatments in that we increased the production of the well. There were two or three jobs that we did for the Columbia Oil & Gas Company where we ruined a working barrel and a few joints of tubing. There were two or three treatments where we did damage to wells belonging to the Columbia

Oil & Gas Company. I just don't recall now, but I remember that we made a settlement with them. It says here in the ledger book "credit of $175.00." That settlement was made September 30, 1932. I have a personal knowledge and recollection of the details of those difficulties with the superintendent of the Columbia Oil & Gas Company. The trouble was that we left the acid in the well too long, or something. At different times we didn't have the best pumps in the world. A pump would break down or something and we didn't get enough oil in behind the acid.

Q. (By Mr. Lyon): Well, in other words, you were just starting in in this business in June, 1932, and it was something new and you didn't have the best equipment and you naturally had some discrepancies and difficulties at that time? A. Everybody was having trouble at that time.

Q. Was Dow having trouble? A. Every one of us.

Q. They were having troubles of the same kind? A. Sure.

Mr. Wiles: Of course, that is pretty bad hearsay, unless the witness knows.

Mr. Lyon: The witness is answering.

The Court: I will let him answer. But I will ask him, how do you know they were having trouble? A. Hearsay.

The Court: Yes, but who told you? Did you get it back through that Lee and his brother that was with you? A. I imagine so. I don't recall now.

The Court: Maybe that communication works both ways, you see.

Mr. Owen: Maybe.

The Court: Only I recognize a difference. You have supplied the witness at the other end of a telephone line.

Mr. Wiles: Sure.

The Court: And they haven't. All right.

The next account in our ledger book, PX-213, appears on page 7 and is that of the Tolbert Oil Company. I see a pencil notation on this page reading "To be paid by Dougherty and Markey." I don't know what that means or what was to be paid. I do not remember this. Dougherty.

was myself and Markey was my partner. I remember the Tolbert Oil Company. There were three acid treating jobs done for the Tolbert Oil Company using acid from the Pennsylvania Salt Manufacturing Company. All of these treatments were successful. I do not recall any pipe trouble or any corrosion on any of these jobs. After October 18, 1932, we treated five wells for the Tolbert Oil Company using acid that came from the Grasselli Company, I imagine.

The next account in our ledger book appears on page 9 under the heading James & Voorhees, and shows that one acid treatment was made on August 24, 1932, for this company. I believe that this job would have been done with acid that came from the Pennsylvania Salt Manufacturing Company. And then another job was done for this company on October 10th and another job on October 24, 1932. The acid that was put into these last two wells may have been acid from either the Pennsylvania Salt Manufacturing Company or from the Grasselli Chemical Company. These acid treating jobs were successful. I do not recall any claim or trouble with respect to damaged well tubing, or any complaints in connection with these jobs.

The next account occurring in our ledger book, PX-213, is that of the Peerless Oil Company. I remember this company. Our accounts show that on August 30, 1932, we treated one of their wells using 1000 gallons of acid. I believe that this well was treated with uninhibited acid from the Pennsylvania Salt Manufacturing Company. On September 28, 1932, we treated another well for this company using 1000 gallons of acid and I believe that this acid also would have come from the Pennsylvania Salt Manufacturing Company. On October 23, 1932, we treated a third well for this company using 1000 gallons. The acid used in this treatment more probably came from the Grasselli Chemical Company. Our accounts show that all three of these acid treating jobs were paid for. There was no claim of any refunds or damages to any pipe on these three jobs as I recall.

The next account in our ledger book, PX-213, appears

on page 13 and is the account of John Arthur, Inc., of Mt. Pleasant, Michigan. This account shows that on October 1, 1932, we treated a well with 1000 gallons of acid, and that on October 5th we treated a well with an amount of acid unstated here. These wells may have been treated with either Pennsylvania Salt acid or with Grasselli acid. I do not recall any trouble in connection with these wells.

The next account appearing in our ledger book, PX-213, is the account of the Gordon Oil Company. This account appears to be pretty well scratched up. I cannot account for the state of the writing in this account. I do not know much about this thing. The account for the Gordon Oil Company shows that on October 4th we treated a well with 1000 gallons of acid and charged $175.00. Then on October 4th we treated three wells in Kentucky. This is the same Gordon Oil Company of Mt. Pleasant, Michigan, who presented us with the bill for $175.00, PX-209, and to whom we paid $175.00 by the check dated October 9, 1932, PX-210. I cannot, by looking at this account, point out the particular treatment and the date of the treatment on which the damage is said to have occurred or claimed to have occurred, and in accordance with which we paid them $175.00. I cannot find under the account of the Gordon Oil Company any record of a treatment or transaction corresponding to what is reported to be reflected in these Exhibits PX-209 and PX-210. I cannot find that in this book. The first item under the account of the Gordon Oil Company appearing in our ledger book, PX-213, carries the date of October 4. I do not know who wrote these entries in this book. They are not correct because we treated one well for the Gordon Oil Company on the Taulker lease, and that is where I went out to look at the tubing, but that is not on here at all. I do not know the date of that treatment. It does not look to me as if anybody has been altering or erasing this book, or changing the account of this Gordon Oil Company. Only just here where they wrote the names of the leases down and somebody had got it wrong here. They wrote in here in pencil the leases. They

haven't even got the Taulker lease on here at all. I suppose that this girl here that used to work for Ed Lee did this writing and kept these books. I do not have a well history or log for each of these wells here in addition to what appears in this book. I did not keep a well log or well history of these wells.

The G-Lee-P Oil Company were in the business of producing oil. They were one of our customers.

The Court: What is your best memory as to how many wells you treated with that raw acid you got from the Pennsylvania Salt Company? **A.** Oh, I would say probably thirty-five or forty.

The Court: Now, I want to call your attention, it is hardly fair to mention them, and it wouldn't be if I didn't tell you that I checked it while listening with both ears to the testimony, but if I have added it right you paid this company (Pennsylvania Salt Manufacturing Company) down there $1220.94, and somebody has told me that that acid was .067 a gallon. And then if I divided right that would make 18,276 gallons, and I multiplied it by 2 because I diluted down to the 15 per cent. That makes 36,552 gallons. And then I divided by 500 because the previous witness said that with this raw acid they usually used only 500 gallons. I haven't asked you that yet. And that would make 71 wells. I have given you all of my figures, so some of you can check those, and I would rather be shown wrong than to take the time to re-check them here.

Mr. Owen: I think most of the treatments that this witness has referred to in the book here were 1,000 gallon treatments.

The Court: Well, with this raw acid?

Mr. Owen: Most of them.

Witness (continuing): Most of the treatments we made we used 1000 gallons of acid. All of the treatments did not use 1000 gallons of acid, there were some treatments made with 500 gallons of acid. We treated the greater percentage of wells using 1000 gallons of acid. I think we did this all the way through whether we were

using raw acid or inhibited acid. I rather think that we advocated using 1000 gallons of acid for each treatment from the very start. We did treat some wells using only 500 gallons of acid, but I don't believe we ever treated any wells using more than 1000 gallons of acid. The treatments appearing under the account of the McClanahan Oil & Gas Company show that most all of these treatments were made using 1000 gallons of acid.

The Court: And your estimate, then, is pretty good. I have made my estimate. I get you up to 35 treatments if I run all 1000; he knows some were 500. That gives you some idea, anyway. I wish somebody would check those figures. It wouldn't surprise me at all if I was away off. I haven't checked a single figure.

The Witness: From a standpoint of increased production to these wells, we had just about as much success and just as good results when we used the acid from the Pennsylvania Salt Manufacturing Company as we did when using the acid from the Grasselli Chemical Company.

Q. (By Mr. Lyon): And how many out of those 36 jobs, how many settlements did you have to make in all? I mean how many times did you have to pay and how many times did you actually give a free job?

The Court: The trouble in answering that now is that he says he hasn't been able to tell how many of them were with the Penn and how many were with the Grasselli acid.

Mr. Lyon: That is right.

The Court: I guess he had that in mind but if he wasn't able to define the difficulties in the first instance as between Grasselli as to the whole, I don't see how he can answer this. He can tell pretty readily where most of the troubles came from. A. All the troubles came from using raw acid.

Q. I understood you had some other trouble. A. As I recall, one instance in Texas where we used inhibited acid.

Mr. Conner: You were speaking about the trouble you had in Texas; did your acid come from Grasselli when you used it in Texas? A. Yes, it must have.

Mr. Lyon: It is a pretty fair statement that the amount of trouble that you had you can, from your knowledge of the business, attribute to the fact that you did not have the best equipment, and that you were new in the business, and did not carry out the acidizing operation as successfully—as efficiently as you might have with more experience and better equipment? A. Well, now that wasn't exactly the trouble either, because of that one instance here of the Gordon Oil Company, we stayed there all afternoon and all night putting that shot in, and we could just start the pumps up and run them about five minutes at a time, until the pressure would crowd it up to 1000 pounds on the tubing.

Q. How long was the acid in contact with the tubing, inside the tubing, on that job, do you know? A. From 10 o'clock in the morning until about 4 the next morning, I think.

Q. Under modern conditions, at the present day, there would not be anything like that, would there? A. Oh, surely, it sure would, because if you get that type of formation, you can't put only so much pressure on your tubing.

Q. Don't they re-circulate the acid out now—isn't that the practice? A. Oh, yes, they would take the acid out, I suppose.

Q. And so if they ran into that condition now they would re-circulate the acid and take it out of the pipe—you know that, don't you? A. Yes.

Q. But you didn't know enough to do that then? A. How do you mean, re-circulate it? Take it out?

Q. Reverse the circulation and take it out, or pump it out, reverse the circulation and take it right out of the well—isn't that the practice? A. Yes.

Mr. Owen: What do you understand by this re-circulation? A. Turning the pressure outside of the tubing and shoving the acid back up the tubing again. This will not take all of the acid out of the well hole.

Q. It wouldn't shorten the time of contact between

the acid and the tubing, would it, this re-circulation process? A. Well, they could probably retch it out so you could—you could today, so that the acid wouldn't be on the tubing for the length of time it used to be.

Q. When you went to put in the next shot it would have to go down in the same tubing, and it has the same obstruction to overcome, doesn't it? A. Yes.

Q. So that taking the entire treatment wouldn't the acid be in contact with the tubing just about as long today as it was when you made that treatment? A. I would think so. It has all got to go back in again.

Q. You would think there wouldn't be very much difference in the time? A. That is right.

Mr. Lyon: Are you familiar with this method, actual use of it that I am talking about? A. Yes, I have seen it done.

At this point there was read to the witness the following from the Halliburton manual:

(Reading): "It has been the practice when a well refused to take acid at a reasonable rate of speed to withdraw the acid and start over again.

"On any job, with or without penetrating acid if not more than 100-150 gal. of acid per hour is being put into the formation, reverse the flow and start in again. This should be done after about one or two hours trial."

Witness (continuing): I understand that method of re-circulation, and it results in pumping the acid out of the pipe. The practice is to use oil to re-circulate or to reverse the circulation, so that the oil comes up underneath the acid and flows or forces the acid out of the pipe.

Mr. Lyon: I don't know whether they save it or start with some fresh acid. They could do either one. A. I was wondering, because oil is so much lighter than acid, as to how they would mix.

This is the modern practice of re-circulation when acid treating an oil well, and I did not do this when treating the Gordon oil well.

The ledger of the Oil Makers Company on page 15,

under the account of the Gordon Oil Company shows no record of any pipe or pump trouble for this company, nor any account of pipe or tubing trouble. There is no record in this book of any claim or refund or of making any refund to this company. I have in mind the instance where we had a claim from the Gordon Oil Company and I was on this job myself. Why it was not put in the book I do not know. I cannot tell you now the date of the job that I have in mind. I think that the job was done before the first job entered in this book. That is October 1, 1932. It was done before that I think. It was about one of the first wells that we treated for the Gordon Oil Company. The first well appearing in this ledger book that we treated for the Gordon Oil Company is dated October 4, 1932. I do not recall the date of the job on which we had trouble. I do not know whether we used acid from the Pennsylvania Salt Manufacturing Company or from Grasselli Chemical Company on the job for the Gordon Oil Company on which we had trouble.

The next account appearing in the ledger book of the Oil Makers Company, PX-213, appears on page 17 and is the account of T. L. McColl, Mt. Pleasant, Michigan. Under this account it shows that on September 27 we treated a well using 1000 gallons of acid. I recall that this treatment was paid for and that it was successful, and that there was no damage done to the well or tubing. When I say no trouble or damage I am talking about trouble or damage to the well tubing or pipe. When I am talking about success of the treatment I am talking about the fact that the acidizing was accomplished successfully so far as what we were aiming to do, namely, to increase the production of the well.

The next account appearing in our ledger book, PX-213, is that of the Michigan Oil & Gas Company of Mt. Pleasant. It appears on page 19. This account shows that we made three treatments for these people without any trouble at all, and that the jobs were done successfully. I recall that the jobs were successful and there was no

trouble. One of these jobs was done early in October, and I cannot say what kind of acid was used on these wells.

The next account appearing in our ledger book, PX-213, is the account of the G-Lee-P Oil Company of Midland, Michigan. We got a check from them for $100.00 and gave them a rebate of $75.00. This account of the G-Lee-P Oil Company of Midland, Michigan, shows that we did a job for them on October 6, using 500 gallons of acid. We also did a job for them on November 4, using 1000 gallons of acid. On this last job there was a $75.00 rebate, so that we gave them back $75.00. The acid treating job on which we gave them a rebate was made with Grasselli acid. There will be another man, I think, that can tell you all about that. He put the acid in the well. The rebate that I am talking about in this case is one where we treated a well for the G-Lee-P Company with acid from the Grasselli Company and we made a rebate of $75.00 to them. That rebate is shown here in our account.

The next account appearing in the ledger book of the Oil Makers Company, PX-213, appears on page 23 and is the account of R. D. Malcolm. It shows that we did three jobs for this company. On October 24 we did a treatment using 1000 gallons of acid and on December 6 we made a treatment using 500 gallons, and on December 7 we also made a 500 gallon treatment for them. All of these jobs were paid for, but we have done more work for this company than appears in this book. We had trouble as a result of treating their wells.

Q. When did you have that? A. About some of the first work we did, I think.

Q. Did you have any trouble with the Grasselli acid, do you know? A. I don't believe we used any Grasselli.

Q. What about this job in December? A. Oh, that must have been—we treated about the first wells we treated for them.

Q. That shows when the company was organized, before the incorporation. A. Might have been.

Q. And therefore it wouldn't be in this book? A. I

believe one of the first wells we treated was for the Malcolm Oil Company.

Q. Did you have to give any adjustment? A. Yes, free shots. ~~Two~~ I think.

Q. Those shots were with the Penn Salt uninhibited acid, the free shots? A. Yes.

Q. And they worked all right? Had no trouble on free shots? A. Yes, there was trouble on two or three of them. I know it was all settled by two free treatments.

Q. And that fixed it up? A. That fixed it up.

Q. Those free treatments were made with the uninhibited Penn Salt acid? A. I think so.

Q. Those were before the incorporation. Now the next account is the one on page 25 which is Nelson & Witt. That also has a lot of scratching and pencil erasures and so forth, like the Gordon account does it not. It doesn't look clean like the other accounts I have called to your attention.

Mr. Conner: I would like to have counsel point out any erasures on there.

Mr. Lyon: Well, the witness can look at it. There seems to be a lot of additions.

The Court: I don't think counsel thinks there has been any tampering with the book. I have no idea of that at all.

Q. It doesn't show that you paid anything to them here, does it? A. I don't know. We will have to go through and see.

Q. This is Nelson & Witt about whom you have testified before? A. Yes.

The first job entered here in this record is August 11 when we treated a well using 500 gallons of acid. The job was successful. That is with respect to increasing production of the well. They were all successful. There was no trouble or damage on this job as I recall. I am quite sure that this job of August 11, 1932, was made using acid from the Pennsylvania Salt Manufacturing Company. There was another treatment made for this company on the same date, August 11, 1932, also using 500 gallons of acid, and

there was not any trouble on this well, as I recall. The next treatment we made for this company was on August 20, 1932, when we used two shots of 1000 gallons of acid each. I do not recall that there was any trouble on this job. And it is my understanding that this well was also treated with uninhibited acid from the Pennsylvania Salt Manufacturing Company. The next treatment made for this company was on August 22, when we used 500 gallons of acid to treat a well, and this acid also came from the Pennsylvania Salt Manufacturing Company, and I do not recall that there was any trouble on this job. The next treatments for this company were made August 31, on which date we made two treatments using 500 gallons of acid each. There was no trouble with these treatments. On August 31 we treated another well for this company using 500 gallons of acid, making a third treatment on that date, and there was no trouble on this treatment that I recall, and the record does not show any trouble on this treatment. I don't recall of any trouble, although this bill that these people presented to me for $60.00 for damage, I don't recall whether it was paid. The next treatment made for these people was on August 27, when we treated two wells using 500 gallons each. There were five wells treated for this company on August 27, in all. I do not recall any trouble on these treatments. I believe that all of the wells treated for this company up to this date of August 27 were treated with acid that came from the Pennsylvania Salt Manufacturing Company. The next entry that I have under this company's account is dated October 8, when we treated a well for them using 500 gallons of acid. I do not remember any trouble with that well.

According to this ledger the last treatment made for this company was on October 15, when we treated a well using 500 gallons of acid. Our total charges to this company, as shown by this account, are $2025.00. It is already totaled here on the account. Someone totaled it, but I did not. Now the payments made by this company to the Oil Makers Company are on August 20, 1932, when they gave

us a check for $270.00. On August 27 they gave us a check for $405.00. On September 21, they gave us a check for $405.00. Someone has entered without a date a further check and the book bears the mark "ask Ed," it says, for $405.00. Maybe Ed has got the check. October 7 they gave us a check for $270.00 and October 15 they gave us another check for $270.00, showing a payment of the full balance of $2025.00. There are no records here on this account of any claim or damages being paid or anything like that. I do not remember any trouble or damages in connection with this company. Mr. Markey was looking into this account, and what that settlement was for I do not recall. I wasn't over at Muskegon where these wells were located, to amount to anything.

The next account appearing in the ledger book of the Oil Makers Company is the one on page 27, and is the account of Witt and Wyant. This account shows that on August 13 we treated a well for them using 500 gallons of acid and I do not recall of any trouble in connection with this treatment. The second job for these people is on the same date when we used 500 gallons of acid. The third treatment we made for these people was on August 31 when we used 500 gallons of acid. In all, during August, we treated four wells for these people, and they were probably all treated with acid from the Pennsylvania Salt Manufacturing Company. I do not recall any trouble that we had in connection with these treatments. Our account ledger shows that these treatments were all paid for in full.

I believe it is correct to state that this ledger book of the Oil Makers Company, PX-213, does not carry any items showing a treatment made in Michigan after the date of December, 1932.

The next account occurring in the ledger book of the Oil Makers Company, PX-213, appears on page 29, and is the account of the Dixie Oil Company. This account shows that on September, 1932, we made a treatment for them, charging $125.00. On October 7 we received by check payment of $125.00. I do not remember any trouble in

connection with this treatment. The Dixie Oil Company was a subsidiary of the Standard Oil Company.

The next account appearing in the ledger book of the Oil Makers Company, PX-213, appears on page 31 and is the account of Cliff-Warner of Muskegon. This account shows we made one treatment for this company, but the date of the treatment does not appear in the book. We were not in shape in the summer of 1932 to be giving away acid jobs in order to get business. The account under Cliff-Warner, the one treatment for this company does not bear any charge for this work. I cannot tell from the record of this company what happened. There is no date showing when this treatment was made, and I do not know what happened there. As to this job which there is no date and no charge in the ledger book, I cannot say whether we did the job or not. Under this account there appears that we made treatments for this company on October 8, 14 and 15, using 500 gallons of acid. There is no charge appearing opposite the job which was on October 8. The acid treatment performed for this company on October 8 could have been made using Grasselli acid. I do not know if it was or not. I have no recollection as to whether there was any trouble in connection with these jobs or not.

The next account appearing in the ledger book of the Oil Makers Company, PX-213, appears on page 33 and is the account of George Davis of Muskegon. This account shows that we treated one well for him in September of 1932, making a charge of $135.00. The account shows that we received by check $66.03. I do not remember this particular job and I cannot explain this account.

The next account in our ledger book appears on page 35, and is the account of T. K. Buzard. This is in the Layton field. His address is Mt. Pleasant, Michigan. I remember this account. I remember the work that was done. There were two acid treatments performed, on October 29 and on November 30. The ledger book does not show any charges made for these treatments, but I remember that these treatments were paid for.

The next account appearing in the ledger book appears on page 37 and is the account of Schuster and White of Kalamazoo, Michigan. The account shows that we did two jobs for these people, on November 11 and November 29, using 1000 gallons of acid for each job. I remember these jobs. We finally got our money from the treatment of the Dennis No. 1 well. We drilled the wells to start with, but this Mr. Bierbacher did not make his payment for the lease and the well, and McClanahan Oil & Gas Company took the lease and well back, and they paid us for the acid treatment. We had trouble getting money on the other treatment, because Schuster was away a good deal to start with.

The last account appearing in the ledger book of the Oil Makers Company is on page 39 and is the account of Mr. Robinson of Mt. Pleasant, Michigan, and shows that we made one treatment for him on December 2, 1932, using 1000 gallons of acid. We did not get our money for this treatment. We have not gotten our money yet for this treatment. We just could not collect. He did not protest the job, however.

The treatments about which I have testified here are the only ones that appear in this book. I think that this ledger book was started and kept by Edgar Lee's bookkeeper at Midland, Michigan. That is the same girl who signed these checks. Afterwards we took these books over to Mt. Pleasant, Michigan, and kept them in our office there. After they were transferred to Mt. Pleasant they were no longer kept. After that most of the work that we did was done in Texas.

The Court: I will say about the books, while I am thinking about it, on the record, that they impress me as being honest, but partial, not complete. They are not kept so that there could be a trial balance taken off. They are not that kind of books. Any fault I have to find with them is that there isn't more of it.

Mr. Lyon: Do you think from your best judgment that this book, PX-213, contains an entry of probably all the jobs that the company did from the time it was incorpor-

ated up until it finished acidizing here in Michigan? A. Perhaps not all of them, no. There were some few after we took the books over, I know.

I think that I took these ledger books from Midland and took them over to Mt. Pleasant, Michigan, some time in December of 1932 or January of 1933, just about that time. After that there was not much work done in Michigan. Most of it was done in Texas. There is nothing in this ledger book about our work in Texas. We have books showing what work we did in Texas. I do not know whether I brought those books with me or not. I have a couple of boxes of them.

Page 65 of the ledger book, PX-213, under the account with the Grasselli Chemical Company shows the following purchases of acid from that company. A car of acid from this company was received on September 21, a second car on September 29, a third car on October 17, a fourth car on October 24, and a fifth car on November 12, all of 1932. These entries show the receipt of acid from the Grasselli Chemical Company, and I imagine all of this acid was used in Michigan. The next entry is for November 17, and in parentheses is "car No. 6." Apparently this acid was also received and used in Michigan. The seventh car of acid from the Grasselli Chemical Company was received December 7 and was used in Michigan. The eighth car of acid from the Grasselli Chemical Company was received December 8 and there is a notation in the ledger book, PX-213, stating Texas. The ninth car from the Grasselli Chemical Company was received December 20 with the notation Louisiana. I believe that the acid for these treatments was received and used in Texas and Louisiana. After the receipt of this ninth car of acid from the Grasselli Chemical Company on December 20, I believe that we received other acid from this company and that it was shipped to Texas and Louisiana.

I did not interest Mr. Pitzer in this acidizing business in Texas. He was not in the acidizing business at that time. He is the gentleman who later started the Chemical Process

Company. What I did was to demonstrate by treating a well for him using uninhibited acid that I bought in Ft. Worth. The acid treatment was very successful and there was no trouble with the pipe. I did not charge him for this acid treatment; it was a free job, that is, a demonstration. I believe that I did previously state that I had not given any free treatments. I did say that, but I didn't have this treatment in mind then. I do not recall that there were any other free treatments that we gave. I think that this was the only free treatment we ever gave. That is, the first free treatment we gave and the only free treatment we gave was when we first went down to Texas to demonstrate this acid treatment to Mr. Pitzer and to get started there. This was the first treatment that we made in Texas and we wanted to know how the acid would work ourselves. This treatment was made in Texas between Breckenridge and Ranger, south of Breckenridge, and we were treating a limestone formation. It was an old well, about 10 or 15 years old. The well was making about 8 barrels, as I recall, and was pumping. As a result of the treatment the well production was increased to 270 barrels, I believe. These wells were all big wells back in the flush days when they were originally drilled in. I would say the well's original production had been around 2000 or 3000 barrels. They were big wells. I think this well was about 3600 feet deep. This free treatment for Mr. Pitzer was made, I believe, in November of 1932. As a result of making this treatment for Mr. Pitzer we made some more jobs in Texas and we sent a man down there. We built storage tanks in Breckenridge and shipped acid from Cleveland, Ohio. I do not recall if we made any more acid treatments for Pitzer. I came back from there.

I do not know anything about the complaint we had in Texas as a result of using Grasselli acid. Mr. Edgar Lee would know about that. All I know about it is what I recollect from talking with him. I don't recall where it was. I do not know what Mr. Lee did about this complaint. The Dow Chemical Company, or rather Dowell, Incorporated, later went down into that field to acidize wells while we

were there. They were competitors of ours, and they were in Louisiana while I was there. The reason that our company was unsuccessful and had to go out of business was that the price of oil went down in Texas and Louisiana. It was just impossible to make collections. No one wanted to treat their wells to increase production when they weren't getting enough money for their oil.

Mr. Lyon: Well, if you had had the resources even mildly comparable to the Dow Company to carry through that kind of a situation is there any reason that you know of why you couldn't have gone ahead with the business and made a success of it? A. Well, yes, there is one reason why we couldn't. We weren't large enough and there were a lot of the small operators that wouldn't allow us to put acid in their wells because they were afraid of the suit against them by The Dow Chemical Company.

Q. Afraid of being sued— A. (Witness interposing) —by The Dow Chemical Company, yes. They wrote letters to every producer in this field, every company we would treat a well for they would get a letter from The Dow Chemical Company, they were liable to suit with us for infringement.

The Witness: I do not recall anything about The Dow Chemical Company notifying our customers that they expected to get a patent some time in August. I do not know anything about this. I remember the letter that I got from The Dow Chemical Company stating that we were infringing.

Q. And you got that letter before you actually had ever used any Grasselli acid, where you had actually acidized a well with Grasselli acid? A. I think so, yes.

Q. Now, this Moline Oil Company that plaintiff says he gave $67 to in settlement of some claim for damage, do you remember that situation? A. I don't recall that is correct. I know I made a settlement with Mr. Wolmer.

The Witness: There is no record in our ledger book, PX-213, about the trouble that we had with the Moline Oil Company. My recollection or my knowledge of this cor-

rosion trouble is from memory. I was not present when this oil well of the Moline Investment Company, on which we damaged the tubing, was treated with acid. I do not recall how long the acid was in the pipe. I did see the tubing that had been injured. It was pretty badly eaten up around the threads. There was several hundred feet of it, the bottom part of the tubing, where the threads were corroded. I do not know what happened by way of settlement, or how we arrived at this figure of $67.00 in making the settlement. I forget now just how that was. My partner was over there doing this work and he got in a mix up with Mr. Wolmer and they couldn't come to a settlement and I went over with him.

Mr. Lyon: Did this $67 represent the full value of it or the full price for that, for the number of sections of pipe that were damaged, the threads that were damaged, or did you just pay some part of that value? A. I might be mistaken on this $67. I might have gotten this by looking this over the other day. I don't know what I did settle with him for.

Q. How much do you think you paid him? A. I know it was a pretty good allowance. He was about to throw us both off his front porch that afternoon.

A lot of these people for whom we were treating wells, and with whom we were dealing, were acquaintances of ours here in the community in Michigan. They were not strangers to us and many of them were people that we were dealing with and had met from time to time. We did not want to get into any arguments with them. We wanted to give them the benefit of any doubt in these settlements and to incur their good will in connection with any further business.

I did not see the tubing that was damaged of this Moline Oil Company before it went into the well, but I think it was new tubing. I do not have any knowledge of the condition of this tubing or how old it was before we acidized the well, but it looked like new tubing. I did not know or understand at the time that we were in this business and

when we were making these settlements, that an inhibited acid would attack rust to just the same extent that raw or uninhibited acid would attack rust. I do not even know that now.

Mr. Lyon: You didn't distinguish in any question of damage to the pipe or even threads or anything like that, between the action of the acid on rust and the action of the acid on good, unrusted metal? A. Well, I knew that it would attack a rusty pipe a lot quicker, but I thought an inhibitor would work on old pipes the same as on new.

Q. Did you think the inhibitor would prevent the acid from acting on rust? Was that your idea at that time? A. Not on rust, no.

Q. I am trying to get at this: Was it your idea that it was safer to run an inhibited acid down a badly rusted pipe than it was a raw acid, at that time? A. No, I didn't—

Q. (Interposing): You thought it would be just as dangerous to run an inhibited acid down as a raw acid? A. Just as dangerous?

Q. Yes? A. Well, I wouldn't say whether or not it was—no, the uninhibited acid would, of course, be more dangerous on any pipe, isn't it?

Q. Well, I am asking you in the case of a rusted pipe, so far as the rust is concerned, what was your understanding? A. Well, they use acid to clean rust from pipe.

Q. That is right, and it will— A. (Interposing): Dip it in.

Q. Does it made any difference whether it is inhibited or not? I don't care what you know now; I am not asking you to testify as an expert now. I am trying to find out what you knew about this business when you were making these settlements? A. Well, I didn't take it in consideration.

I do not know whether the $67.00 paid to the Moline Oil Company represented a full settlement for the full value of the pipe that was corroded. I do recall that there was several hundred feet of tubing spoiled and they had it laid out beside the well.

Q. Do you know the date or the approximate date of the acidizing of the well that that claim arose out of? A. It was early in the fall of 1932. It was a real hot day.

Q. I am sure that I am not reliable on when the fall starts here in Michigan. About what date could it have been, between what days? As near as you can tell us. A. We could tell by the book we just went over.

Q. I didn't think we found any trouble in this Moline camp. A. I can tell you about the time of the treatments of the wells. And those wells would find out about the tubing right away, because they put those back to pumping, and would find out there was something wrong.

Q. That is a fine thing. They didn't even put the Moline Oil Company's name in the index. I have got to go through the whole book. A. Wolmer. Find his name.

Q. No such name in this book. I don't find any account with the Moline Oil Company or Mr. Wolmer in this book.

(Witness speaking to counsel.)

Mr. Lyon: The witness says that he thinks that account isn't in this ledger, PX-213.

The Court: That probably means that it didn't occur during the period that that book covers. A. Oh, yes, it did.

The Court: During that same period? A. It did.

The Court: Well, then, there is some accounts evidently that are not in that book at all. A. Yes.

The Court: If you are right about that. A. That is right.

The Court: I thought—I had hoped we had a book that was fairly complete for the given period, but that it did not start during the partnership, until the corporation, and then it ended with about the year 1932, but now I have got to subtract from some of my good opinion from it, and say that there were accounts and actual transactions of the same kind that weren't reflected in there at all, you think. Is that right? A. Yes.

The Witness: There wasn't much work done by the Oil Makers Company, if any, in Michigan after December

of 1932. The Oil Makers Company stopped its operations in Texas shortly after the bank holiday, which was some time about in February of 1933.

Q. (By Mr. Lyon): Can you tell me something about these ledger sheets? These seem to be just a few sheets out of something, out of somewhere. Is there a ledger book that these came out of? A. Yes, I think there is a lot more of those.

Q. Can't we have the whole book? A. You want me to go and move all those files here?

Q. I don't want you to do that. But you only had about thirty-five accounts. You can't have such a big ledger, so many ledger sheets. A. I did bring over a lot more this morning, when I came.

The Court: You are willing that he see them, aren't you? A. Yes, he can come up and go through the whole thing up there, if he wants to.

Mr. Lyon: I want to do that.

The Court: Well, let me see. It is time to adjourn. It is half past five anyway. You let Mr. Lyon see anything you have got.

Next day—the witness continuing:

At the adjournment last night I delivered to Mr. Lyon, counsel for defendant, four envelopes containing various assortments of papers concerning this Oil Maker Company that I have been testifying about. These envelopes were not in any particular order. I have examined the letter to which you call my attention, dated February 7, 1933, Shreveport, Louisiana, and addressed to the Oil Maker Corporation, Mt. Pleasant, Michigan, and signed Edgar S. Lee. That is the Mr. Lee who was associated with our company and who testified here yesterday. This letter was received by our company in the due course of mail, and I recognize Mr. Lee's signature. The letter starts out with (reading):

"The following is a list of the wells that we have treated under the Coates contract: Paree No. 2, Stile No. 2, Sabine No. 1 and No. 2, Towery No. 1 and No. 2, Hale No.

1. Then there are several paragraphs referring to the financial situation in regard to these wells. This is a report from Mr. Lee, who was down in Louisiana, reporting to our company on the status of the work that our company was doing there. Then there occurs in this letter a paragraph as follows: "The Rotary Oil Company is $100.00 cash and $600.00 to be paid out of one-fourth of the increased production." This refers to the fact that our Oil Maker Corporation was making deals down in Louisiana for acidizing wells and we would get so much cash and so much pay by way of oil as a result of the increased production.

The letter continues and reads as follows: "In treating this well the boys had trouble with their pump, had a high pressure to overcome, and they did not get the acid entirely out of the drill pipe. Consequently this first shot was a failure. We ate up three or four joints of drill pipe, which we will have to replace, and also shoot the well over, which we have already done. As yet we don't know what the increase will be." This well that is referred to in this letter was acidized by our company using Grasselli inhibited acid. I think this is the well I was trying to think of or refer to yesterday.

At this point the letter above referred to was offered and received in evidence as DX-216.

I remember being interested in a company called the Petroleum Investors Corporation a couple of years ago. Mr. Lee was not interested in this company, ut I was interested in this company in the capacity of president. I know William F. Brown.

Mr. Lyon: Mr. Brown testified in this case relative to the acidizing of that well by the Halliburton Oil Well Cementing Company in the name of Petroleum Investors, Inc. To shorten the matter—I will read it at length if there is any question about it—Mr. Brown stated that he was representing the Dow Company and that he was authorized by the Petroleum Investors Company to order that well acidized in the name of the Petroleum Investors Company by the Halliburton Company. Have you any knowledge of that situation at all? A. I k

Q. Is it true that you authorized Mr. Brown to represent to the Halliburton Company that he was a member of the Petroleum Investors organization and to order that well acidized by the Halliburton Company in the name of the Petroleum Investors Company so as to conceal any interest that the Dow company might have in that transaction? A. Well, as I recall it, I ordered it myself from the Halliburton, Mr. Brown paid the Petroleum Investors and we, in turn, paid the Halliburton.

Q. Why did you authorize Mr. Brown, if he wasn't employed by the Petroleum Investors Company, to use the name of the Petroleum Investors Company in dealing with the Halliburton Company? Did you know that Mr. Brown was acting for the Dow Company? A. I wasn't told definitely but I surmised that he was.

Q. Why did you allow the name of your company to be used on behalf of the Dow Company in that transaction? A. Why did we order the shot?

Q. Why did you allow Mr. Brown to use the name of your company in ordering that acidizing job done by the Halliburton Company if you knew Mr. Brown was bringing that about for the benefit of the Dow Company? A. I don't recall that Mr. Brown ordered the shot. I had Larry King up in the office, went through all the details, and ordered the shot myself. Went through all the details of the oil well treating.

Q. I show you the order to the Halliburton Oil Well Cementing Company, date 4-24-1939, and the name of the Petroleum Investors Incorporated, and it is signed William F. Brown. Is that Mr. Brown's signature, do you know? A. It is.

The Witness: The order to the Halliburton Oil Well Cementing Company dated April 24, 1939, to treat the Petroleum Investors Company's well and signed William F. Brown was not made out before the treatment. I have examined the letter on the stationery of William F. Brown, dated April 19, 1939, addressed to the Petroleum Investors Company, Inc., Dougherty & Markey, Inc., Olympia Build-

ing, Mt. Pleasant, Michigan. These are companies of which I am the president, and the Dougherty and Markey mentioned in this letter are myself and partner. This letter reads as follows:

"Since I am desirous of obtaining certain acid treatment information for a client, and since you are desirous of having a well treated, I agree to pay to you the full charges made by the Acid Treating Company for the treatment of the Knight No. 2 well, located in the southwest quarter of Section 16, Hay Township, Gladwin County, Michigan.

"The conditions which I require are:

"That I choose either Dowell or Halliburton Company to do the work, specify the type of treatment, and be present during the full operations of treatment.

"Also, I shall require average daily production figures for ten days before and ten days after treatment.

"If the above arrangement will be satisfactory to you, please denote your approval below.

"Very truly yours,

"William F. Brown.

"Approved, H. H. Butterfield, for Petroleum Investors, Inc., and Dougherty & Markey, Inc."

I recognize Mr. Brown's signature on this letter. Mr. Butterfield is our secretary. I authorized Mr. Butterfield to approve that letter. I surmised who the client was that Mr. Brown represented. I surmised it was The Dow Chemical Company. I was quite satisfied that it was The Dow Chemical Company. I believe I knew the purpose of this transaction was to obtain evidence for The Dow Chemical Company of the acidizing of the well by Halliburton. I wish to make another statement. Mr. Brown was employed by the Petroleum Investors as a part time geologist, but this transaction was not part of his employment. I understood that Mr. Brown was representing The Dow Chemical Company and that he was reimbursing the Petroleum Investors Company for the amount of money that would be

paid Halliburton for this acidizing job. I didn't understand that, I wasn't told definitely by Mr. Brown, that this was leading to a law suit or anything of that kind, or that he was getting the money from the Dow to do this, but I surmized this because we got a treatment of acid for nothing. Mr. Brown brought over the cash. There was nothing told to me. He didn't even bring over his own check. I surmised there might be some hitch somewhere and I didn't want to be mixed up in it in any way, but I was told nothing about it, any more than that Mr. Brown would pay personally for the acid shot. I am the party who was representing my company in making the original deal with Mr. Brown. I am the only one in my company that made this deal with Mr. Brown. I agree that this deal was one whereby I made an agreement to get this well treated by the Halliburton Company and it wouldn't cost me anything. The rest of the transactions were merely to carry them out in such a way as to have it to look the way they desired it to look.

Mr. Brown called me over the phone and asked if we had any wells that we were planning on treating with acid again, and I told him that there was. We had not used Halliburton or Dow, either one, up to that time. Not at all. We used Mr. Quinlan. He had done most of our acid work. Mr. Brown told me that if I got this particular well ready that he would see that we got a shot of acid free of charge. I asked Mr. Brown just what that was letting me in for, what the mix up was, and he said, "That won't let you in for a thing. I will pay you personally for the acid treatment." I told him to go ahead, and so he made all the arrangements. Mr. Brown asked me to make the arrangements so as to get Halliburton to treat the well. That was the first start of the conversation after he found out that we were planning on treating this well.

The Court: Well how did you know he was interested in the Dow? What is there back of that as far as you were concerned, so that you understood? A. I didn't know.

He doesn't work for the Dow. He has no position with the Dow that I know of.

The Court: You said you surmised it was for the Dow. A. I do.

The Court: Where do you get that idea? A. Because I heard a lot about this suit coming up, and that was for a long time, and I imagined that they had Bill as a go-between—that they had Mr. Brown as a go-between.

Q. (By Mr. Lyon): You have mentioned that this Knight well, which is the one we are talking about, had not been treated before. I wish you would stop to think about that. It is my understanding, although I may be wrong about it, that that well had been acidized before with no increase in production. I don't know by whom. Do you remember? A. Well, we had an increase on all the Knight wells, as I recall.

Q. Do you remember whether this Knight No. 2 well had been acidized before this deal? A. Well, I don't know.

Q. Before you made this deal with Mr. Brown or for Halliburton to acidize it? A. I don't recall whether it was. It came in pretty good.

Q. Do you know what results were obtained by the acidizing of the Knight No. 2 well by Halliburton, pursuant to your arrangement with Mr. Brown? A. It increased the water and both the water and the oil.

Q. You abandoned the well, did you not? A. We have.

Q. The job was not successful? A. Well, I wouldn't lay it to the acid treatment.

Q. Well, the acid treatment did not do you any good, you might put it that way? A. No, not particularly.

Q. And you have abandoned the well? A. We have now.

Q. I mean, how soon, you abandoned it how soon after the well was acidized by Halliburton? A. Probably six months.

Q. But you didn't get any benefit by Halliburton's acidizing the well? A. No.

The Court: Was there any blanket used? A. Yes. We used a blanket.

The Court: Who made the arrangement, now, and decided there would be a blanket used? A. I did.

The Court: No one influenced you in that regard? A. No, no.

The Court: You had a free drink, and did what you wanted? A. Yes.

The Court: By the way, how big a shot did you take?

Mr. Lyon: For your information. Two gallons of blanket and 1500 gallons of Penn acid.

The Court: But you did decide for yourself whether the quantity of acid you would have would be so and so? A. That is right.

The Court: Now, was there any choice of inhibitor, or the percentage of inhibitor that you had in it? A. I don't recall that there was.

The Court: You just decided, all you had to decide then was the quantity of the acid, which was of one kind, and the quantity of the blanket, which was one kind, as I understand the situation? A. I believe that is true.

The Court: You did decide that; Brown didn't have anything to do with deciding that, or Halliburton didn't? A. That is right.

Mr. Wiles: The way they run their operation, they take their storage acid and bring it in the Menaul tank and what it gets on the way is what the customer gets.

The Court: That is the way I understand. Now that was all the kind it was and he got it in that way. There wasn't anything said by you as to how long it would remain in the tank before it was used? A. No.

The Court: Did you know anything about that at that time? A. No, I didn't.

Mr. Conner: I will read the last stipulation that was entered into by Mr. Babcock, at Midland, on Tuesday, April 15, 1941.

(Reading): "Mr. Babcock: Counsel for plaintiff has produced tickets apparently signed by the pumper on the

Knight No. 2 well, Petroleum Investors, Inc., from April 16, 1939, to May 4, 1939, and after a discussion of these tickets between counsel it is stipulated that if this pumper were called, whose name appears to be W. R. Pauley, he would testify that the data on these tickets is correct. And it is further stipulated between counsel that these tickets show that before the well was treated its production was approximately 2.7 barrels per day and that after the well was treated its production was approximately four barrels per day. I request that this stipulation be used in lieu of the one I entered into yesterday."

The Court: Now, that is a nice form of stipulation for both of you to make. It does not tie my hands, or either of your hands, if somebody else is called to get at the facts. However, when they get them, there is nothing that changes that testimony at all, and I am carrying forward the idea now that that increase was about as that witness would say, very small, and that in addition there was enough brine so that the well had to be abandoned.

Q. (By Mr. Lyon, continuing): As I understand it, Your Honor, the run tickets covered the few number of days following the acidizing, commencing on April 16 and running up to May 4, just a short time.

The Court: Can you give us any idea how long that increase continued, or whether it fell off, Mr. Dougherty? A. Well, it gradually fell off.

Q. It gradually went down? A. Yes.

Q. As a matter of fact—you may look at this run, this job ticket on the well, in connection with the acidizing, 85 barrels of oil were pumped into the well, were they not? A. There was.

Q. So those barrels may be responsible for the two barrel increase that evidences itself in the few days following the treatment? A. No, that don't—

Q. Do you not count it in that way? A. We don't count it in that way, until we get the oil back.

Q. I see. A. It is like salting a gold mine, Your Honor. You get your salt back, but sometimes the fellow that owns it thinks he is getting new gold.

The Court: You kept track of the oil? A. We took the oil, kept the oil that was put in one of those sheets for every one of the tanks. The tank was gauged, Your Honor.

The Court: That seems to be a very small amount? A. Yes.

The Court: You generally get better results than you got in that case? A. Yes.

The Court: I take it that there probably was not much water before your treatment? A. No, we weren't getting much water. We just couldn't afford to operate it at a loss.

The Court: Can you give me some idea as to the proportion of brine to oil, your first measurement? I am taking these figures, that there were two barrels a day afterwards. Do you know how much brine you were getting? A. About 50 per cent.

The Court: When does brine become so great that it is impractical to try and save the oil? A. It depends on the size of your oil production.

The Court: Because if you get too much brine, there just isn't anything that you can do with it in the field? A. No.

REDIRECT EXAMINATION

When we treated the well in Texas for Pitzer and West we bought that acid from Houston, Texas. This was raw acid. I believe that this treatment was done some time after we had been using Grasselli acid. This treatment for Pitzer and West was an experimental treatment and we didn't want to go to the expense of shipping or hauling a truck load of acid into Texas all the way from Ohio. That is the reason we did not use the Grasselli acid. We were not getting any pay for this experimental treatment. I recall that the acid went into the formation of the Pitzer and West well in Texas right away with no delay.

I am not positive, but I believe that we had sent trucks to Grasselli two or three times to buy acid in small quantities before we started to purchase it in carload shipments.

This would probably have taken place a week or two before we started to buy it from Grasselli in carloads. Referring to PX-207, check 46, September 19, 1932, for $475.00 would be for a carload. The check dated September 20 and the two checks dated September 23, and made payable to the Grasselli Chemical Company, were in payment for truck loads of acid. I think that these three checks might have been in payment for truck loads of acid purchased from the Grasselli Chemical Company. I do not recall whether any of the Grasselli acid was purchased by truck load prior to the earliest date appearing on these three checks. If such purchases of acid from the Grasselli Chemical Company were made prior to the dates of these three checks, I believe they would have been paid for by check, because we had established credit before we started to buy acid from the Grasselli Chemical Company. That is we had established credit before that time. I didn't look for any stub book. There is a lot more stuff up there.

I have examined Exhibit PX-216, being a letter from Edgar S. Lee to the Oil Makers Corporation dated February 7, 1933, and I note the pen and ink notations thereon. These notations look like our secretary's writing, that is Mr. Butterfield's writing. These notations state "OK on books." That does not mean anything to me.

Mr. Lyon: The papers that were delivered to me did not contain any ledger sheets or any checks or anything else about the business down in Texas or Louisiana, but it contained letters back to the company of every kind and description asking for money, and I think the witness will agree with me that they were in very bad financial position at that time. The men down there were writing for their pay and the Grasselli Company was refusing to ship acid and shipping it on a basis that required payment, and the company was unable to pick up a car of acid after it got down there. There is a whole series of wires about a car you couldn't pick up. A. Yes.

The Court (interposing): We haven't got the books here, but I was just inquiring if you think there was a rec-

ord kept, and, if so, who kept it? A. It was a terribly mixed up affair along at the last.

I do not recall whether or not the Oil Makers Corporation did any advertising other than possibly inserting a notice in the Oil & Gas Journal of June or July of the year 1932.

Mr. Owen: How did your business grow, by what means was it promoted? A. Results.

Q. What kind of results? A. Increase in production.

Q. What is the fact in the oil industry in Michigan about the way news travels about anything that happens in the industry that is of importance or interest? A. It is a very good grapevine.

Q. One operator tells the next one? A. Sure.

Q. And they are in pretty close touch with what others are doing all over the distiict? A. That is true.

Q. That applies to the different fields in Michigan? A. It does.

Q. They all know each other and they communicate information? A. That is true.

Q. At that time if an oil operator got a substantial increase in production through such a treatment what was his attitude of mind, as communicated to others in the industry? A. Oh, well, when one operator got good results why he was—

The Court: Pretty tickled? A. Why, sure, and everybody else knew about it.

Q. And if he got good results in the way of increased production what would you say about his likelihood of objecting to or overlooking slight damage to his equipment? A. There was a lot of them that did.

The Witness: I identified a letter which was written by The Dow Chemical Company to the Oil Maker Company, which is PX-199. I believe that we received a copy of the patent No. 1,877,504 in connection with that letter. The other operators in the field who were using these acid treatments, other than the treatments given by Dow, were pretty generally notified by Dow regarding this patent.

I recall that I saw some of these other letters other than the letter to our own company. The language in these other letters received by the other companies was practically the same as the language in the letter we received. In the letter that I received it states: "You are respectfully requested to immediately discontinue the use of acid in any manner which would infringe the rights secured to us by the aforesaid patent."

This letter was dated September 23, 1932. At that date I do not know whether or not The Dow Chemical Company knew that we had been using raw acid. I had not told anyone that we were using raw acid.

The Court: Was that brother working with you, or with Dow at that time that he is asking about? A. Lee, do you mean? No, there are two brothers, one in the produce business now, and one with the Dow Company.

The Court: Was one of them with you at that time? A. Yes.

The Court: And the other one was with Dow at that time? A. That is true.

The Court: There was just the same opportunity, but no better and no worse, than there was for that particular grapevine to be working.

In connection with this acid treatment given to the Petroleum Investors Company Knight No. 2 well by the Halliburton Company, as a result of my agreement with Mr. Brown, I called Larry King of the Halliburton Company, and he came up to my office and we talked the treatment over. There were no papers signed at that time when I talked with Larry King. Whatever papers were signed in connection with that treatment were signed at the well. I do not recall that I authorized Mr. William Brown to sign papers for me in connection with that treatment, that is to represent me at the treatment. I do not believe that the Halliburton Company or anybody connected with them knew at that time that the treatment was to be paid for by The Dow Chemical Company, or by anyone other than my own company. I thought that we were getting the regular

treatment, and I did not suppose that Halliburton had anything but one kind of treatment that they were giving.

I had connected with my company either before or after it was incorporated, that is the Oil Makers, a man by the name of Sprenger. His work was that of doing the actual work in the field and he worked for us during July, August and September, I believe, of 1932.

RECROSS EXAMINATION

I have referred before to the fact that 85 barrels of oil were pumped into the Knight well No. 2, which was the well treated by the Halliburton Oil Well Cementing Company in connection with my agreement with Mr. Brown. This amount of oil, 85 barrels, was more than the well tubing in the well would hold. I do not know whether or not the Halliburton representative protested against pumping that oil into the well. The arrangement for pumping that oil into this well was not made in advance at my office. That arrangement was made between Mr. King, the Halliburton man, and the lease superintendent in charge of the Petroleum Investors Company's wells. It is true that the actual details of what was to be done on that well were settled out at the well at the time of the job, and I was not there then. Mr. Brown was then present representing The Dow Chemical Company. Mr. Walter Pauley was present representing the Petroleum Investors Company. I knew what was to be done at the well and what procedures and steps would be taken, as I talked the treatment over with Mr. Pauley, the superintendent of the well. No one decided that 85 barrels of oil must be put in, because no one knew that the well would take that much. In treating a well you fill the well hole with oil both inside and outside the pipe. That is to keep your acid from coming up outside of the tubing. I suppose, in putting that oil in, the 85 barrels, they were trying to fill this hole up, which wouldn't fill up. I do not know whether the Halliburton people made any criticism or any protest about putting this oil into the well

in attempting to fill it up, when the well was taking the oil. I was not at this well at the time of the acid treatment. I heard about the treatment after it had been treated.

I have examined the Halliburton acidizing ticket for this Knight well No. 2, which is signed by W. F. Brown. I identify his signature and this record or ticket is a schedule of the time of operation, and it shows that the acid was in the pipe for 30 minutes on its way going down to the bottom of the well.

Mr. Lyon: How many minutes? A. Well, the acid started in at 5 o'clock, at 5:05 there had been 500 gallons pumped into the well, at 5:10 there had been 1000 gallons pumped into the well, at 5:15 there had been 1500 gallons pumped into the well and that is the end of the acid. At 5:30 there had been 16 barrels of oil circulated. So that it took 15 minutes for the entire amount of acid to get through the pipe on this job. That is for the 1500 gallons of acid, according to this ticket. The oil went into this well first. They put 85 barrels of oil into this well and the 85 barrels did not fill up the well hole.

WALTER SPRENGER,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

I live in Allegan, Michigan, my business is that of building contractor and producer. I have been in that business for myself for 4 years, prior to that I was employed by the G-Lee-P Development Company. I have had no connection with the Oil Maker Company, that is not by that name, but I was associated with the same gentlemen who organized this company. I was connected with the organizers of this company before the company was organized and not afterwards. The gentlemen I refer to are Edgar Lee, Charles Dougherty and Fred Markey, with whom I had a sort of gentlemen's agreement. I was actually in charge of the treatments, and treated the wells.

The arrangement between Mr. Lee, Mr. Dougherty, Mr. Markey and myself was made some time in the latter part of July, 1932, and I continued working with these gentlemen up until about the middle of October, 1932. I was in charge of the well treatments made by this organization during that period. I wouldn't say that I treated all of the wells treated by this organization during that period, but I did treat most of them. The Oil Makers Company was organized some time after the middle of October, 1932, about which date I left this organization. I do not know how much time intervened between the date when I left the organization and the time that company was incorporated.

Mr. Lee would buy the acid and bring it to the field. I do not know whether or not they had any bank account at that date. I did not handle that end of it. When the company was finally organized they called themselves the Oil Makers, but to my knowledge they did not call themselves the Oil Makers during any time while I was with them. I have with me some notes that will help me fix the date when

I first began to treat wells for this organization and when I severed my connections with them.

At this point a book produced by Mr. Sprenger was offered and received in evidence as PX-217.

This book contains other data that does not apply to the Oil Makers and my association with the men I have referred to. The notes in this book were entered at the time that the work was done, and they have been in the book ever since.

At this point four pages of notes from Sprenger's book were offered and received in evidence as PX-218A, B, C and D.

I do not have a record in this book of the first well that I treated. The first record that I have is dated June 22, 1932. This record appears on the page marked PX-218-A. The record under the date of June 22, 1932, refers to the Mooney well No. 2, and indicates that 6 carboys of acid were put into the well with a bailer. 80 barrels of oil were used. This well was treated for Goll-Graves and Meckling. This treatment was made before I made the arrangement with Mr. Lee, Mr. Dougherty and Mr. Markey. I was employed by Goll-Graves and Meckling to do this work. I was regularly employed by Goll-Graves and Meckling at that time and I took care of a lease for them and they had me make this treatment. The acid used came from the Detroit Chemical Company and was delivered to us by truck. I signed the invoices and the bill of lading for the delivery of the acid. Six carboys of acid were used and we put it in the well with a 6 inch bailer. We first took the pumping equipment out of the well and then put the acid into the well with the bailer and lowered it to the bottom of the well, where we dumped it by striking the dump bailer on the bottom of the well. I was told that this was concentrated acid.

Mr. Graves had us treat the well this way and we washed the well down with fresh water and washed our bailer and then we pumped 8 barrels of oil on top of the acid and held it there for 24 hours. My notes do not show

what results we obtained from this treatment, but of my own knowledge I know that this well was producing 5 barrels a day and after the treatment the well made 180 barrels per day. I do not know how long this lasted, but the production gradually tapered off, but it made a commercial producer, and is still producing. I used the acid just as it came to us in carboys. My job was to do the work on this well and I had perhaps two helpers. I didn't make any special charge for this work. I operated these three wells on these two leases and I operated these wells for so much a month. I got $25.00 a well per month. I furnished the pumper and operated the wells for these people. I was doing similar work for other operators. I had a number of wells I was looking after.

At that particular time I took care of six wells for the G-Lee-P Company and one well for Schuller, Wilson and Strange. I think that was all the wells I had charge of at that particular time. I didn't make this bargain to acidize this well or buy the acid. My job was that of taking care of the well and while I was doing that they had this work done and I was there while it was done and worked around with it. I actually did the work. The reason I did this work is because I had treated some wells for the G-Lee-P Company before this. Goll-Graves and Meckling bought the acid and what I did was to put the acid into the well at their instruction. This was not my scheme at all, they figured this out.

I have kept those notes for my private information. The next well that I treated was the Mooney No. 3 on June 29, 1932. Eighteen carboys of acid and 85 barrels of oil were used. This well was treated in the same way as the other well and was treated for Goll-Graves and Meckling. It was one of their wells. We didn't get very good results. We built up a 300 pound pressure on the casing head. That well is still producing. We put in 85 barrels of oil and pumped the pressure up to 300 pounds and let it stand. I don't remember exactly what the results were with respect to increased production, but that well made something less

than 50 barrels after the treatment. Before the treatment it was making just a few barrels. The statement with respect to production is from my memory. The acid used in treating the Mooney No. 3 well came from the Detroit Chemical Company.

During the month of June, 1932, I treated some wells on the Grubb farm for the G-Lee-P Company, but I have no records on this. The records are in their files. These wells were treated before I treated the well for Goll-Graves and Meekling.

The next well that I treated, and on which I have notes, was treated July 24, 1932. I used 1000 gallons of acid, but I do not know of what per cent. The acid came from the Pennsylvania Salt Manufacturing Company of Wyandotte, Michigan, and was received by us in wooden tanks. The acid came to us in Mr. Edgar Lee's trucks. We had one large tank with two compartments in it. The well was named the Hastings No. 1 well and was owned by Wells and Malcolm, and was located in Greendale Township, Michigan, and was the first well I treated after my arrangement with Mr. Lee, Mr. Dougherty and Mr. Markey. I received the acid in the field and put it into the well on this first treatment by pumping the acid down the tubing of the well.

I did not put any money into this organization or company and I did not draw any out. I knew how to handle the acid and knew how to use it and it was built up around that knowledge of mine. My understanding was that if I stayed with these gentlemen I would profit and share alike in the company if it was a success. This was just an oral understand'ng. I was to do the treating of the wells and Mr. Dougherty and Mr. Markey would furnish the money, while Mr. Lee furnished the transportation for the acid, and if we made any money we were to share equally. The reason I quit this business was because of the losses we sustained.

In treating the Wells and Malcolm Hastings well No. 1 we did not do the well any good and caused a lot of damage by way of damaging the tubing. I saw the tubing. I saw the tubing after the treatment and after the tubing had

been pulled from the well. The bottom part of the tubing was badly eaten around the threads and collars. I do not remember just how far up from the bottom of the tubing that the tubing was eaten. There were several hundred feet of it that had been eaten. I know that a complaint was made by the owners of the well. What the owner of the well told me wouldn't be very permissible here, and they would not allow me to go upon their lease again. I have no record of this damage. In treating this well we put in some oil on top of the acid. The well carried 500 pounds pressure on the casing head and from 250 to 300 pounds on the tubing.

This Hastings well No. 1 treated for Wells and Malcolm was the first well that this organization ever treated. A short time after the treatment my partners, Mr. Dougherty and Mr. Markey, told me that they had made an adjustment with the well owners because of the damage to the tubing.

Mr. Lyon: I move to strike the answer, Your Honor. It is incompetent.

The Court: Who told you and when did they tell you and where were you, and who was present? A. Well, Dougherty and Mr. Markey.

The Court: Anybody else there? A. I don't remember.

The Court: When did they tell you? A. A short time later.

The Court: What did they tell you? A. They told me that they had to pay for that string of tubing.

The Court: Is that all they said? A. I don't remember.

The Court: You don't know how much? A. No, I did not.

The Court: You don't know how long a string of it? A. I don't know what adjustment they made.

The Court: All right.

The next record of a well treatment that I made while working with Mr. Dougherty and these other gentlemen was on July 26, 1932, when I treated the Struble No. 1 well

for the McClanahan Oil & Gas Company. My notes on this well appear in my book on the page that is marked PX-218-B and my record shows that we put 1000 gallons of acid in that well and that we had no pressure on the casing head, and in the tubing we had a vacuum. I put the acid into the well just as it came out to me in the truck. Mr. Lee brought the acid to me. My notations here show that 367 barrels of oil were produced from this well in the first 24 hours after the treatment. I do not know what the production of this well was before treatment. I never heard of any damage done to this well as a result of treating it.

Also on the page of my notes marked PX-218-B I find the next entry regarding these treatments. On July 27, 1932, I treated a well for the Stork Oil Company. I do not have the name or number of the well, but I used 1000 gallons of acid in making this treatment. The casing head had a pressure of 100 to 300 pounds, while the tubing pressure was 100 pounds. This well made 80 barrels of oil the first 10 hours after being treated, but I do not know what its production was before treating. I never heard that any complaint was made about damage to this well from treating it. I do not know how long the acid was in the tubing.

According to my notes the next treatment that I made to a well was on July 30, 1932, when I treated the Root well No. 1 for the McClanahan Oil & Gas Company. I used 1000 gallons of acid in this treatment and no pressure. In these four treatments where we used 1000 gallons of acid we borrowed a pump from the Dixie Oil Company and pumped the acid in through the tubing. I do not know the results of treating the McClanahan's Root No. 1 well. There was no damage resulting from this treatment to my knowledge. There were no complaints. In all the subsequent treatments we pumped the acid in through the tubing.

My notes show that the next well I treated was on August 1, 1932, when I treated the Cole well No. 1 for J. C. Arthurs, using 1000 gallons of acid and no pressure and no oil. I have no records as to the results of this treatment and I never heard of any damage as a result of this treatment.

The next well I treated on August 2, 1932, for the McClanahan Oil & Gas Company. The well was the Morrison No. 2. There was very little pressure and we used 1000 gallons of acid, which was pumped in with a Dixie pump. We used 80 barrels of oil. The majority of these wells were treated on a vacuum after the acid started working. I have no record as to the results of this treatment and I do not remember whether or not any complaint of damage was made as a result of the treatment.

These well treatments that I have been testifying about are treatments that I made and recorded in my personal notes. During this period the organization had no one outside of myself doing this work at the well and I made all of these treatments I am talking about. The treatment of the Morrison well No. 2 for the McClanahan Oil & Gas Company on August 2, 1938, is recorded in my notes on the sheet marked PX-218-B.

Next I treated a well known as the Hastings No. 1 on August 6, 1932, for Wells and Malcolm. I had already treated this well but this was after Mr. Malcolm quieted down a little bit and allowed me to come back and retreat it. After I had treated this well the first time the lease owner wouldn't talk to me or have anything to do with me. Mr. Dougherty and Mr. Markey had made some adjustments with Wells and Malcolm as a result of the first treatment to the Hastings No. 1 well, but what adjustments they made I do not know. So I treated this Hastings well No. 1. They had put new tubing into the well in the meantime. I used 1000 gallons of acid with 50 pounds of pressure on the tubing. I do not remember the result of the treatment. It was a small well. I never heard of any damage being caused by the second treatment. When I treated the well the second time I did not treat it any differently from when I treated it the first time, but in the meantime the well had been shot with glycerine, which opened up and cracked the formation and the formation took the acid the second time. The acid went in much more quickly than it did on the first treatment.

I would go out on these wells and work day and night and sometimes would make these notations later on. Some notations I made at the well and some I made right at my office after I got in.

The date of the next treatment is recorded on the back of PX-218-B, and is dated August 5, 1932, a day earlier than the last treatment I was telling about. This treatment was made for the Stork Oil Company and we treated their Coon well No. 4 using 1000 gallons of acid and no pressure. We used 60 barrels of oil and pumped it in with a Dixie pump. I do not remember the results of this treatment. Some time during this treatment for the Stork Company they made a claim for damage, but this claim for damage was not handled through me. I do not remember whether this claim for damage was in connection with this particular treatment or not. There is nothing in my notes which will show which well they were complaining about.

According to my notes the next treatment I made was August 7, 1932, when I treated the Schaeffer well No. 1 for the G-Lee-P Oil Development Company. I used 1000 gallons of acid. On my notes I have pressure marked here, but there is no mention of the amount of pressure used. Sometimes our gauges would be eaten up during the process of treating and we wouldn't know what it was doing. I don't remember how much pressure was used. Not being a chemist I don't know what kind of acid was used, that is, I don't know what the strength was. I had nothing to do at all with diluting the acid. I used the acid as it came to me in the field. Mr. Lee brought the acid out to me and it would come in his trucks, on which were mounted wooden tanks. The acid always came to me in wooden tanks. I do not have any records here to show the results of treating the Schaeffer well No. 1.

Usually the head man of the oil company told us what strength of acid to use. In the case of the Schaeffer well it would have been Mr. Laurence Lee, president of the G-Lee-P Oil Company. There was very little known about it at that time and that was a pretty slipshod method of

doing it. The man who owned the wells would also tell us how much acid to use. Mr. Dougherty and Mr. Lee would handle most of this part of the business end. It was part of their job. My part of the job was simply to get the acid down into the well.

On this Schaeffer No. 1 well belonging to the G-Lee-P Oil Company I was what is called a "farm boss" and worked for the G-Lee-P Company and had charge of this well. On this well we didn't do it very much good and damaged a considerable amount of tubing. This particular string of pipe was electric weld pipe and the acid ate the weld out and also attacked the collars, threads and working barrel. I saw the tubing myself. We had to replace between 500 and 600 feet of tubing of this well and it was new tubing that we had used only a few days. When we pulled the tubing out of the well it was all split.

Q. Was it split at the weld? A. It was split when we pulled it out of the well.

Q. At the place where it was welded, along the seam? A. Yes.

Q. How badly was it split? So that it was way open? A. No, not like it would be from pressure. Just the weld was eaten out.

The Court: Is there anything about that on here? A. No.

The Court: Well, what is the most important thing about that well from your standpoint? A. What do you mean?

The Court: Well, what is the important thing that happened from the time you went there until you went away from the standpoint of your company or organization? A. We tried to make it produce more oil. It was not a commercial producer as it was. We treated it to make a commercial well of it.

Q. Did you put oil in that well after the acid? A. Seven inches, it shows. That would be about 18 barrels.

Q. That would be seven inches from the tank? A. Yes, in a 500 barrel tank.

Q. And you say that your association replaced the 500 feet of damaged tubing? A. I don't think there was any claim made for tubing. The company replaced it themselves.

Turning to the next page of my notes, marked PX-218-C, they show that the next well I treated was on August 8, 1932, for the Columbia Oil & Gas Company. The well was the Hornick No. 3. I used 500 gallons of acid and no pressure. A Simmerell pump was used to put the acid into the well. We had completely ruined the other pump and could not use it any more, so we borrowed this pump. Eventually we ruined it also. I do not remember the results of treating this Columbia Oil & Gas Company well and I never heard that any damage was done to the well as a result of treating it.

The next well I treated was on August 9, 1932, for the McClanahan Oil & Gas Company. The well was the Schaeffer No. 1, in which I put 1000 gallons of acid. I applied 450 pounds pressure to the tubing and 900 pounds pressure at the casing head using the Simerell Pipe Line Company's pump. This was the second well on which I used this pump. The Schaeffer No. 1 well of McClanahan is about two miles from the G-Lee-P Company's Schaeffer No. 1 well. The Schaeffer well No. 1 produced 80 barrels per day originally. It only did this for a few days and then went right down to almost nothing. After the acid treatment and we got the well fixed up, it pumped its original production again. Both the McClanahan Oil & Gas Company and the G-Lee-P Company have wells named the Schaeffer No. 1. The McClanahan Oil & Gas Company's Schaeffer No. 1 well originally produced 100 barrels and after it was treated it produced 1000 barrels per day.

There was some damage done to the McClanahan Oil & Gas Company's Schaeffer No. 1 well, but I don't think we ever had to make any settlement for this damage. I know there was some damage as I was told about it and I later saw the damage. This well flowed for months and months, but when they attempted to put the well to pumping it

wouldn't pump and they had to find out why it wouldn't pump and when they pulled the tubing out they found a damaged working barrel and so on. I saw the tubing and pump after it had been pulled out of the well and it was laid out on the ground. I didn't examine it very carefully. They told me they could not make the well pump and that the barrel was damaged from the acid. This tubing was replaced, but our company did not replace it. The owner of the well did this. This Schaeffer well No. 1 of the McClanahan Oil & Gas Company was treated August 9, 1932.

Referring to the next treatment in my notes, I find that on August 11, 1932, I treated a well for Witt & Nelson of Muskegon, Michigan. There was no pressure on this well and they furnished a pump from the Dixie Pipe Line Company. I never heard what results were obtained from treating this well and I never heard whether any damage was done to the well or not. I do not know the name of this well.

The next well that I treated was on August 15, 1932, according to my notes marked PX-218-C. This well was treated for the Michigan Oil & Gas Company, but I do not have the name of the well. The acid was put into the well with the Mt. Pleasant Cementing and Mudding Machine pump, but I do not have any records of the pressure or the results of the treatment. Neither do I have any record of the amount of oil used. I have no record that any damage was done to this well.

According to my notes the next well I treated was on August 16, 1932, for the Columbia Oil & Gas Company. On this day I treated two wells, each with 500 gallons of acid. I do not have the names of the wells and I do not have any records of the pressures used or the results of the treatments. I never heard of any damage being done to these wells as a result of treating them. My records on these wells appear in my notes on the page marked PX-218-C.

The next well I treated was on August 18, 1932, for the Columbia Oil & Gas Company. I used 1000 gallons of acid and 300 pounds pressure, using the Mt. Pleasant Cementing

and Mudding Machine Company's pump. I do not know the name of that well, nor what results were obtained by treating it. I do not know whether or not any damage resulted from that treatment.

On August 24, 1932, I treated a well for the Talbot Oil Company. This well was known as the Adams No. 1 and I used 500 gallons of acid and no pressure. I was never told what the results of this treatment were and I never heard of any claim being made for damage to this well resulting from treating it.

All of these wells that I was treating were comparatively new. The Schaeffer well treated for the G-Lee-P Company and the Malcolm well were new wells which had just come in.

The next well that I treated was on August 24, 1932, when I treated a well known as the Jones No. 1. This well was owned by the Jones Oil Company & Voorhies. On this well I used 500 gallons of acid and no pressure. I have no record of any pressure and I have no record of any production or claim for damage. My notes on this well appear on that page of my book which has been marked PX-218-C.

The next well I treated was on August 26, 1932, for Schuller, Voorhies, Wilson and Strange, they were the owners of the well. The name of the well was the Reimenschneider No. 1. On this well I used 1300 gallons of acid, but I have no record of how much oil was used, but my records show that 150 to 300 pounds pressure were employed. I do not remember the amount of oil this well produced, but I think that the acid helped the well considerably. I had charge of this particular well and worked for the people that operated it, and when we went to put this well back to pumping I had to insert a new working barrel.

The Court: What part of this information is from your memorandum that you are looking at, and what part is just from your memory? A. This is just the part from the memorandum, the number of the well, the number of gallons and the pressure, that is what I have here.

The Court: All right.

At this point the witness produced and explained a standing valve which is stationary in the bottom of the pump barrel at the bottom of an oil well, and a working valve which is attached to the lower end of the sucker rod and works up and down in the pump barrel. The standing valve was offered as PX-219 and the working valve as PX-220.

The perforated pipe is located on the bottom, right directly under the barrel. In making these acid treatments I removed the plunger, corresponding to PX-220 and the part corresponding to PX-219. You lower the rod with part 220 attached until it rests upon part 219, and then you turn it and the two are screwed together, so that the part 219 will come out when the rod is pulled. The tubing was left in the hole and the working barrel is always in the hole when you give an acid treatment. If there is any damage to the pumping equipment from the acid treatment, it usually roughens the inside of the barrel, which has a highly polished finish, and then the acid eats the threads out, inside and outside, so far as it comes up on the outside of the tubing, and loosens the collars so that they have to be removed. As to whether the acid affects the valve seat for the part PX-219, I have removed them already when that seat would be so damaged that it wouldn't hold the valve. It only takes a leak, probably a hair to go through, to keep a well from pumping. The most damage would be your valve would be roughened so that it would cut these cups and it would only last a few hours.

In connection with the treatment on August 26, 1932, of the Reimenschneider well No. 1 for Schuller, Voorhies, Wilson and Strange, I had to put in a new working barrel. This was because the working barrel had been damaged from acid standing in the well. In order to insert a new working barrel it was necessary to pull the entire tubing. There was no claim made for damage on this well. I was in charge of the well and when it needed servicing I had it done. We did not request compensation from the Oil Makers or from my company for this damage. I merely reported my findings to the owners of the well.

The next well I treated was on August 28, 1932, for the McClanahan Oil & Gas Company. The name of the well was the Struble No. 2. I find a report of this well on the page of my notes marked PX-218-C. I used 1000 gallons of acid in this well and 75 barrels of oil. The well was treated under 800 pounds pressure. We had some complaint there on damaged tubing. I do not know what adjustment was made as a result of this complaint. The reference I make to damage is from my memory. I do not remember what the production of the well was before or after treatment.

My next notes as to the treatment of wells appears on that page of my notes marked PX-218-D, and the next well I treated was on August 28, 1932, when I treated a well owned by the Gordon Company and Columbia Oil & Gas Company. The well was known as the Tanker No. 1. I used 1000 gallons of acid in this treatment. We didn't get any results. It was a dry hole. I have no record of what pressures were used on the well. There was considerable damage done to the tubing in this well and also to the casing, but I do not remember what if any settlement was made. I know nothing about what, if any, settlement was made. This well, the Tanker No. 1, is about one and a half or one and three-quarters miles from the Struble well No. 2. In those days it would take me anywhere from a few hours to several hours, or a couple of days, to make one of these well treatments.

I treated both the McClanahan's Struble No. 2 and the Gordon Oil Company and the Columbia Oil & Gas Company's Tanker No. 1 on August 28, 1932. If I remember correctly, the McClanahan well was treated in the morning and I finished up the work in the afternoon. At that time we started in using two trucks and I went over and treated the other well in the night. As nearly as I can remember this Tanker No. 1 well was treated at night. I did not see the tubing and the casing of this Tanker No. 1 well after treatment. I was well acquainted with the farm boss in charge of that well and he told me of the damage that was done. His name was Roy Duke. He now lives about 15 miles out of here in the Wisner oil field.

On September 1, 1932, I treated the Schaeffer No. 1 well for the McClanahan Oil & Gas Company, using 1000 gallons of acid and 300 pounds pressure on the casing and 50 pounds pressure on the tubing. 123 barrels of oil was used. I do not know the esults of this treatment and I never heard of any damage to this well as a result of this treatment. This was the second treatment on this well. When this well was treated the first time they had a damaged working barrel as I recall it. The well production went down and the McClanahan Oil & Gas Company wanted it retreated. The retreating had nothing to do with the damage resulting from the first treatment. So far as I remember when I retreated this well I used exactly the same kind of acid and same method of treating it as I did when I treated it before and damaged it. In each case I used the acid that was delivered to me for treating these wells. This is the well that I referred to as making 1000 barrels of oil after it was treated the first time. I do not know how long the acid was in the tubing on this Schaeffer No. 1 well when it was treated the second time.

On September 6, 1932, I treated a well for the Stork Oil Company. I do not know the name of this well. I used 500 gallons of acid and no pressure. I do not know anything about the results of that treatment and I do not recall that any damage resulted to this well from treating it.

On September 11, 1932, I treated the Schaeffer well No. 1 owned by the G-Lee-P Company. This was a retreatment of the same well and this time I used 500 gallons of acid. I do not remember what results were obtained from treating, but there was no damage done to this well the second time. No pressure was used in this treatment. This is the same well that I had previously treated on August 7, 1932. The first time this well was treated I used 1000 gallons of acid and when I retreated it I used only 500 gallons. The first time the well was treated the tubing was damaged. I do not know whether or not this second treatment to the Schaeffer No. 1 well belonging to the G-Lee-P Company was given in settlement for damage done to the well in the first treatment. I do not know anything about that.

My records show that the next well I treated was on September 12, 1932, for the Talbot Oil & Gas Company. I do not have any record of the name of the well that was treated, but my records show that 500 gallons of acid were used. That is all the information I have on this well and I have no personal recollection whatsoever of the treatment other than these records for this well.

The next entry I have is dated September 12, 1932, and I treated on that date a well for the Columbia and Gordon, using 1000 gallons of acid. I have no record of what pressure was used, nor any record of what the results were. I do not remember of any damage to the well as a result of the treatment. If I remember correctly the Talbot well that I treated on September 12, 1932, was right across the road from the Columbia and Gordon well that I treated on the same day. We treated two wells on that day and the acid must have gone in pretty quickly.

That is all the entries I have concerning wells that I have treated with acid. That is the last well that I treated for this organization, and when I quit working for them I talked with my associates and told them that I was quitting. I told them that I believed that the business was too big for us. We were causing more damage than we were making money to pay for. I also told them that unless we found some way to use the acid without causing so much trouble to the steel material in the well, that it was useless to continue to use it. I talked to Mr. Charles Dougherty, Mr. Fred Markey and Edgar Lee.

Mr. Lyon: I would like to object to this conversation, Your Honor, as not admissible against the defendant in this case, particularly in view of the fact other witnesses who have been here on the stand weren't asked about any such conversation.

The Court: Overruled.

My conversation with these gentlemen took place in my little field office on the Grubb farm. I got no money out of my work in connection with these acid treatments for Mr. Dougherty, Mr. Markey and Mr. Lee.

I received my income from the G-Lee-P Oil Company, for whom I took care of certain wells. Also I took care of wells owned by Charles Strange, Schuller, Wilson and Voorhies. Some of these wells that I treated with acid I was being paid to take care of. So that I was present at some of these wells in two capacities, one because I was being paid to look after them by the well owners and the other because it was being treated by the group of four men, of which I was one.

While working for the organization of Dougherty, Markey and Lee I treated about 27 wells. Some of the wells that I treated I was being paid to take care of by the well owners, but I had no interest in the wells I treated for the Stork Oil Company, the Talbot, the Gordon, or the Columbia Companies, and I had no interest in the Jones wells, nor the Malcolm wells. The owners of these wells were not paying me to take care of their wells, and I did not get paid to take care of the McClanahan Oil & Gas Company's wells, nor the wells belonging to J. C. Arthur. I did get paid to take care of the wells belonging to Goll-Graves and Meckling, the wells belonging to the G-Lee-P Company and the wells owned by Strange, Schuller, Voorhies and Wilson.

In the first two wells that I treated, which were for Goll-Graves and Meckling, I put the acid into the well with a bailer. In doing this the tubing of the well was pulled out and the bailer full of acid was lowered into the well.

After we had treated a well, and the well was flowing oil, there was no way in which we could tell whether or not the equipment of the well had been damaged until after the well quit flowing and the equipment was pulled out of the well. This might be any length of time after the acid was put into the well. As long as the well was flowing we did not operate the well pump. Then when the well stopped flowing and we started to operate the pump we would discover the damage which had been done to the pumping equipment.

CROSS EXAMINATION

None of these notes that I have referred to, PX-218-A to 218-D, record any damage or claim to damage in connection with any of the well treatments I have referred to. I have no records of any damage. My notes and records on these wells I treated were usually written up either at the well or when I came in off the job. I didn't wait and write up several wells at a time. Referring to the notes appearing in my records dated June 22, 1932, and June 29, 1932, these notes were made as I did the work. This was not always at the well. I usually made the record and notes after I got through with the job. I made these notes after I had done the work, usually right after when I went to my office. With respect to the entry concerning the well treated on June 22, I probably made the notes on that well the same day the well was treated.

I certainly think that I did make the notes on the same day that this well was treated, on June 22, 1932. I probably made the notes concerning the well treated on June 29, 1932, on the date the well was treated. I usually did my bookkeeping when I was on the job after my day's work, and when I came in of an evening. I usually carried this little memorandum book in my car, sort of a scout book. I kept records of various things in it.

I have no objection to you looking at the rest of this loose-leaf book from which these pages, PX-218-A to PX-218-D, were taken. I do not think that there are any records of any other acidizing jobs appearing in this book at all. At that time we did not have regular little slips to fill out for the jobs. Later on this organization did have regular slips to fill out, but I do not know when this started.

Mr. Lyon: Now, I have gone through this whole book and so far it is just what you call a log. Would you call that a form for a log? A. Yes.

Q. And it has got data in there, and these are all printed forms of logs. Then we come over here to the end

of the book and we find some blank papers, pages, and there isn't anything on those pages, is there, except these four that you have taken out of here? A. That is all.

Q. So the only thing in this whole book are just these entries on these printed forms of logs, and then these particular four pages? There is nothing else to correlate these dates or they are not—the papers are not in any sequence that you can compare with any records before them or any records after them; is that correct? A. Well, they would correspond with the various companies books records.

Q. I am asking you about this book. A. Well, that has nothing to do with it. That is just merely a notebook.

Q. But I mean here we have a loose leaf notebook made up of printed logs. We have some blank pages at the end, and the only thing, the only writing in these notebooks are these four pages. Maybe there is a couple of notes or a couple of words on one or two of those, but the four pages which you have offered in evidence here from this loose leaf notebook, these are not—the point I am making, Your Honor, is that these do not fit into any diary of any kind.

The Court: Let me ask him, did you treat other wells besides these? A. Yes.

The Court: You have since then? A. Yes.

The Court: How do you keep your records of those wells? A. Since I have been in business myself, I have a bookkeeper and I have everything up in form.

The Court: Well, is this the book you get your minutes from for your present bookkeeping? A. No. I haven't used that book in years.

The Court: Well, what is this, anyway? I haven't read it, or looked at it. A. That book is prepared principally for scouts to keep well records in, go from well to well, into the field, during the process of drilling. There are several thousand dollars worth of business right in that little book. Each one of those records in front there, each page is a complete record of a well drilled. It represents several thousand dollars in each record.

The Court: How is that? A. Each one of those well records means a lot of business.

The Court: Drilling well records, you mean? A. That is right, yes.

The Court: Are you in the drilling business? A. Yes.

The Court: These are records of wells you have been interested in that were drilled? A. That is just some of them.

The Court: That is what I would call a log, maybe. A. Yes.

The Court: Of particular wells? A. Yes.

The Court: What kind of a record do you keep of wells you treat? You say you are in the business now of treating wells? A. No, I don't treat wells now.

The Court: You have treated other wells than these? A. I have had these various companies treat wells for me in the southern part of the state.

The Court: Have you got a record of that? A. We have records in our office of all those jobs.

The Court: All right.

I do not know whether I ever showed the sheets of my notes, PX-218-A to D, to anyone while I was doing this work in 1932 or not. I don't know of anybody that I showed these notes to at that time. I never had occasion to show them to anybody.

I made these records with both a fountain pen and with a pen dipped in a bottle of ink. I had both. Some of the notes are made in pencil. I did not make out all of these notes at the same time. I do not know whether or not I can show you which notes I made with a fountain pen and which I made with a pen and a bottle of ink. I do not know. I am not a writing expert. I carried this book in my car and I made some of these notes at my office and I made some of them at the well. They are my original notes. At the time of making these notes I did not first make some record at the well on some paper and then transfer those notes over into this book.

The Court: Then how would you get—I was thinking you did that. That is the way I was explaining one where you got the 7th of August ahead of the 6th. How can you

explain that? Turn to those sheets that I have in mind there. Let me see if I can find just what I want to call your attention to. Here is where it is. There you have got August 6th commencing ahead of August 5th. Running down the whole page here you have August 1, August 2, August 6th and then August 5th. A. These are crossed out here.

The Court: Yes, it does look as if you changed it. A. I am not a very good bookkeeper. I don't remember.

The Court: I thought an easy explanation was what I said before, but you say that isn't right, that probably you made some memorandum at the well. A. Some was made at the well and some was made afterwards.

The Court: But you say they are all made right in this, a memo of them made on another piece of paper and then transferred in here? A. Well, they could have been in one or two instances, not very many.

If the well was creating any pressure at the top of the well through its own gas conditions, then we had to fill the well with oil before we could pump the acid down. Some of these wells we could fill with oil and some of them we could not. Where I have said that the well had so much pressure either at the casing head or at the tubing or elsewhere, by that I mean that it was a well that I could fill with oil as distinguished from a well that I have called a vacuum well. In a vacuum well, if I attempted to put oil in it, the oil would flow right away into the formation. When I wanted to acidize one of these pressure wells, as I call them, the first step would be to fill the well with oil so that the tubing was full down the inside and the well was full to the top between the tubing and the casing.

In addition to the oil in the tubing and outside of the casing, there would be many wells that would have little channels and outlets in the formation so that the well would have quite a capacity for holding oil in addition to the oil in the tubing and casing. The next step in treating the well would be to pump the acid down through the well tubing. In order to do this it would be necessary to open

up the well at the top between the tubing and the casing so that I could let the oil flow out from there at the top of the well to compensate for the acid that I was pumping into the well through the tubing. Then as I pumped the acid down the well and the oil continued to flow out at the top of the well between the casing and the tubing, I would continue the operation until acid had reached the bottom of the tubing and perhaps just started out of the bottom part of the tubing. I held a back pressure on the top of the casing so that the acid is held in the well where you want it.

When the acid starts to come out of the bottom of the pipe or tubing, it is then necessary to close in the top of the well between the tubing and the casing and stop the upward circulation of the oil. Otherwise the acid will turn around the outside of the tubing and start up the well between the tubing and the casing. Therefore, at some stage or another of the treatment I had to determine when I was going to close in the top of the well and stop the oil from coming up out of the well between the casing and the tubing. After I had closed in the top of the well I continued pumping and the effect of that was to pump the acid back into the formation. I then continued pumping until I had pumped the acid out of the tubing and back into the formation, and after I had got all of the acid in the pipe that I was going to put down into the well, then I pumped the oil into the pipe on top of the acid. I must know how much acid to pump in to get the acid out of the tubing at the bottom.

Mr. Lyon: All right. Now, you have to make a lot of calculations to do that. You have to calculate the volume of the tubing and you have to calculate how much liquid to pump down there, until your acid starts flowing out of your tubing, so as to tell you when to shut off your well at the top, between the tubing and the casing, and you have got to be able to calculate how much fluid to pump in on top of your acid to get your acid out of the tubing; that is correct, isn't it? A. Yes.

Q. Now, that was all new to you, wasn't it, when you

were doing this work? You had never been in the oil field operations which required that kind of calculations and that kind of operations that we are talking about? A. We knew how much oil to put in, certainly, in a given number of feet of tubing.

Q. Well, I mean this, that this business of making this kind of calculations, when you would go out to a well and find a well of a depth you hadn't had before, and operating your pump so as to get in just the amount of fluid you had calculated you should, that was new work to you, wasn't it?. A. Yes.

Q. You had never done it before, you were not an expert or experienced in this kind of operation until you took up this acidizing with pumps? A. It was new to me.

Q. And all the trouble that you had was occasioned by something going wrong and your failing to get your acid out of your tubing or in one or two instances, I think, you said you got some to come back up around the tubing on the outside of the tubing, at the bottom. It was all a case of not getting your acid in the right place, wasn't it? A. No, I wouldn't say that.

In treating these wells I have been talking about I had no trouble with those wells that were treated on a vacuum. In treating the wells that required a pressure, I had trouble because the acid would not go into the formation, so I would keep trying for hours to get the acid into the formation. I did not reverse the circulation in the well and take the acid out of the pipe at the top of the well, but I did take a swab and try to swab out the acid. In some instances where I did have trouble with the well I also tried to swab those wells. I do not know how you are going to determine whether you have taken the acid out of the well fast enough, or how you are going to determine if you have left the acid in the well too long. At the time of treating these wells that I have been talking about I had the only type of equipment that was available at that time. At that time there were no pumps constructed to pump acid. Today they have special pumps to do this that will work in a way

our pumps would not, and that will work under conditions that I encountered when treating these wells. Also today they have better inhibitors.

I have seen the pumps used by the Halliburton Oil Well Cementing Company in acidizing wells, and they have some very fine equipment now. When treating these wells I had little pumps that would pump up against a pressure, but they were not constructed or not built to handle acid. The pumps of that day had fiber packing in the cylinders and pistons and after a few hours of service under pressure they would wear out. These pumps had common brass or steel liners. The pumps I used to pump acid with had some brass or bronze parts in them which contacted the acid. I do not know whether the acid would take out part of the brass or copper, but I do know that after these pumps were used one or two times they had to be thrown away.

Usually the cast iron, bronze and brass working parts of the pump would be eaten out. The equipment used today in pumping acid into a well is capable of some very high pressures. The present day acid pumping equipment is powerful and has plenty of capacity, and there are pumps especially built to assure that acid gets down and out of the pipe against ordinary obstacles. The present day practice is that when the formation will not allow the acid to penetrate, the circulation is reversed and the acid is removed from the well. But we did not do any of these things in 1932.

Of the various acid treatments that I have been telling about, I believe that we encountered trouble and damage to the well for the first time when I treated the Hastings No. 1 well for Wells and Malcolm on July 24, 1932. On this treatment a pump was used and pressure was applied to force the acid into the formation. I do not remember how long the acid remained in the tubing on this well or in the working barrel. The acid was probably in the well for some time, possibly until the next day, I presume. The damage and trouble was caused by leaving the acid in the working barrel. That was one of the first wells that I had

ever had any knowledge of being treated under pressure, and at that particular time nobody knew anything about treating a well under pressure. That was the first well I ever saw treated under pressure and I attempted to do it myself. I did not treat this well the same way that I would if I were going to do it today.

The next well on which we had damage to the tubing as a result of acid treating it was a well owned by the G-Lee-P Oil Company, which was known as the Schaeffer No. 1, and which I treated on August 7, 1932. In this particular case I do not know just what happened, but the acid did come back up out of the well hole. The acid would be permitted to come back up out of the well hole by leaving the well open at the top between the tubing and the casing, or the acid might come back up out of the well hole as a result of a leak in the casing. Sometimes all calculations fail and something happens that you do not figure on. In those days we did not cement our pipe. Today we cement our strings of oil pipe and there is no possible chance for it leaking from the casing seat. I cannot tell what happened in this particular Schaeffer well No. 1 of the G-Lee-P Company, which permitted the acid to come up around the outside of the pipe. I do not know whether this was preventable or not.

The next well that I treated in which damage was done to the well was a well known as the Schaeffer No. 1 owned by the McClanahan Oil & Gas Company. This well was treated August 9, 1932. I do not remember exactly what the trouble was there, but as I recall Mr. Crampton had to replace the working barrel when they attempted to pump this well. This well was increased to 1000 barrels per day as a result of the acid treatment, but I do not remember how long this increase held up before they had to put the well back on the pump. I do not remember how fast the production of this well declined. It wasn't over a month, but I do not remember. In this well that we damaged I would say that the working barrel would cost around $24 to $25, or something like that.

Mr. Lyon: And you had recovered maybe 30,000 barrels of oil because of the acid treatment, I think you admitted this morning, didn't you, that they would have been glad to have bought several working barrels, if necessary, in order to get the results of that acid treatment? A. They were a pretty happy bunch.

I have been a farm boss in charge of oil wells and have had a lot of experience in that line. I have had to pull a lot of pumps and replace a lot of working barrels where there had not been any acidizing in the well at all.

In sand fields the working barrels wear out during the normal pumping operations. In flowing wells you do not have any pumping troubles in connection with your pumping barrels. It is not true that if you allow a well to flow through one of these working barrels that it is common to have them cut off or pit out, so that when you want to put the well on the pump you have to pull the tubing and put on a working barrel. This never happened to me.

I have been farm boss for the Sinclair Oil Company in Texas and Oklahoma, where I was in charge of flowing wells. I was in charge of wells flowing through working barrels, and in south Texas I was in charge of wells that flowed as high as 10,000 barrels. It is, however, a common thing in pumping wells to have to replace the working barrels when they wear out from all kinds of reasons. To replace a pumping barrel is no particular tragedy. It is part of your operating cost of the well.

The next well which I treated and to which damage was caused as a result of the acid treatment was the Gordon Oil Company's Tanker No. 1 well, which I treated on August 28, 1932. In the treatment of this well the acid would not go into the formation as it should and I had to leave the acid in the pipe. That was the cause of the trouble, leaving the acid in the pipe too long, and under present day practices this would be preventable.

The Court: How did you determine how much acid the tubing would hold? A. At that time I had a book that was prepared by the National Supply Company, or the

National Tubing Company, and that gave it to me, and I could look in that and determine at a glance what any size tubing would hold.

The Court: When you were trying to put this acid in under pressure, where did you stop with your acid, I mean where did you leave the acid, try to force it all out of the casing, or did you leave the casing full of acid, or what? A. It was our intention to put it all in the formation.

The Court: And by following it with oil? A. Yes.

The Court: And the amount of oil you followed it was the amount that by your book you had learned it would take to fill that tubing, and then when you thought you had it forced out then you held it right there under pressure? A. Those days every operator had his own ideas. Some would want to leave it there twenty-four hours, and some would want to leave it there seventy-two hours.

The Court: What you thought you had done was to put enough oil in to just fill your tubing, and therefore had crowded all of the acid out of the tubing? A. Yes.

The Court: Isn't that right? A. That was it.

Mr. Owen: To fill the tubing and the well hole around the bottom of the tubing, that is put in enough oil not only to fill the tubing, but also the well hole at the bottom of the tubing, so as to force the acid out into the formation.

The Court: How would you determine the capacity of the oil hole at the bottom of the tubing? A. That is one thing you couldn't do.

Mr. Owen: Can it be done today? A. Yes. Well, it has been—I can't do it, but the chemists, if they know how much acid you have used previously, they can tell you the cavity you should have. They have worked it out.

Q. For re-treatments? A. For re-treatments. They have worked out a system whereby they are quite accurate.

The Court: Well, why can't you work it out this way: You can compute the amount of oil that is in your casing, can't you, and then if you know how much oil you put in—A. There is a lot of things around an oil well you just can't tell how you know it.

The Court: You didn't know how to tell the capacity of the hole at the bottom of the tubing? A. You can't tell that exactly.

The Court: All right. A. Because you don't know how much pressure is there, or how much it is going to take.

Another well which was damaged as a result of acid treating was the Reimenschneider well, belonging to Schuller, Voorhies, Wilson and Strange. This well was treated August 26, 1932. This was a hard well to treat. We probably did not get the acid out of the working barrel.

Another well that we treated and damaged was the McClanahan Oil & Gas Company's well the Struble No. 2, which was treated August 28, 1932. In the well there was some damaged tubing. I never saw the tubing, but I was told about it. I do not know how many joints of tubing were damaged, and I do not know whether the damage was on the inside or outside of the tubing. I was just told we damaged some tubing there but I do not know how I did it. On this Struble well No. 2 I remember that it was a hard well to get the formation to take the acid. The pressure we used in treating this well denotes that it was a hard well to treat. When I say that this was a hard well to treat I mean that the acid would not go or flow into the formation and I had to put a lot of pressure on the acid and still it bucked the pressure. First you must understand that when this oil country was new, they carried a rock or bottom hole pressure in the bottom of the well around 1000 pounds. You take one of those wells and it would be a tight well. It would be a producing well but there would be only a very small amount of porosity in the formation. You had to buck that rock pressure in order to get your acid to flow against the pressure or rock pressure in the bottom of the well hole. In the treatment of this Struble well No. 2 I am confident that the injury to the tubing was caused by the difficulty in getting the acid out of the pipe, and because of the equipment and method we had and knew about at that time.

The Court: In fairness to this witness, I want to ask

him just a few questions, and then give counsel an opportunity to further cross examine him, if he wishes. (To the witness): Am I right in my understanding that these sheets that you have produced here from your little loose-leaf book, were either written just at the time that you treated the well, or shortly thereafter? A. They were written, that is right—they were either written at the well, or on the same night, or the next day at my office.

The Court: And did you have to go back to them and do anything to them after that? A. To rewrite them?

The Court: Yes. A. No.

The Court: And these are just in the condition they were when you first made them? A. Yes. I have not thought of these things for five or six years.

The Court: If there was any damage to any of these wells, how soon after that did you usually learn about it? A. As soon as you had to put your well to pumping.

The Court: How soon? A. If your well didn't start off going after it was treated, you learned about it within a day or so, or as soon as your well blew the head off. If the well started out flowing, and it flowed, you wouldn't know anything about damaged tubing until you had to put your well to pumping.

The Court: About how long would be the early date on that, to hear about that? A. Well, if you treat a well today, and leave it say for 72 hours, and then open your well up, and it didn't flow, you would swab it first; and then if you couldn't make it flow, you would put your pumping equipment in and try to pump it.

The Court: You didn't make the final entry in your notes until after you were through treating. As I understand, you waited, for instance, to tell how much oil you would put in, and how much acid, and all about the pressure and those things. You didn't make those entries until you finished treating, did you, finally make these entries in this book? A. No.

The Court: Did you when you were there find out if there was any damage to the well? I am trying to get an

idea as to when you completed your work. I know that if you are right there you wouldn't be likely to find out about damage unless you were doing something. A. In some places you would know right away, and in some places your fluid would start coming up on the outside of your casing, and in that case you would have to—

The Court (interposing): I will tell you this frankly, what I was trying to do was let you explain to yourself, and if it is not a good explanation, don't take it, but I didn't know but what you made your entries about your treatment of the wells when you were there, as far as the entry was concerned, and you never went back to it and did anything—and, if later on you found out that the well had been damaged, that would explain why you did not get that in there, see? On the other hand, if you were entering it right at the time from your experience, and from your personal knowledge about the thing, I would have difficulty in seeing why you didn't put down damage to something, because it seems as if that would have been the interesting and helpful thing to do. A. The damaged material would show in the company's books that I had charge of at that time but not the other people's.

The Court: I see. I didn't know but if you weren't there at least it would explain the things you didn't hear about until several days later; it wouldn't be on the books.

Mr. Wiles: After you had pumped the acid down and followed it with the oil, did you stick around until it was pumped out again or did you just go away? A. No.

Mr. Wiles: The well operator finished up the emptying of the well? A. They would do their own pumping. When they got ready to open up the well, they opened it up and done what they saw fit. I didn't do anything to those except the wells I actually had charge of.

The Court: The degree of supervision is very far short from what I understand Dow or Halliburton or oil treaters do now, a much lesser degree. A. There is no comparison with what I did and what you do today.

The Court: And the division of labor. You put the acid down in the hole.

Mr. Lyon: I think it would be interesting to the court if you would just explain what you meant by that. The witness said "There is no comparison with what I did and what they do today." Will you just give the court a picture of that difference? A. Well, at that time, we just knew hydrochloric acid would open up the porosity and let the wells make more oil. That was all we were practically interested in. After we started developing the process and began to damage wells and make good wells out of practically dry holes, and spoil good wells, then your chemical engineers entered into the picture.

The Court: How did you spoil good wells? A. By eating out the casing seats.

The Court: That didn't hurt the well. A. Oh, yes, it would. Let the water in from above. If you damaged your casing seat or caused the casing to start leaking in the bottom of the well, the water would start leaking.

The Court: You are talking about casing seats now. You haven't told us of any of that kind of experience you had.

Mr. Lyon: The casing seat isn't some casing. It is some limestone around the bottom of the casing you are relying on to keep the water out, isn't that correct? A. Yes.

The Court: It isn't the other seat we are talking about?

Mr. Lyon: Oh, no. It isn't a metal seat at all. It is the formation you are relying on to keep the water out.

The Court: That would develop with inhibited acid as well as any other acid? A. Yes.

Mr. Lyon: What do they do now that is different from what you did in those days? A. Well, today they have highly trained boys whom they have sent to school and studied these different methods, who are chemical engineers, usually.

The Court: Some of these "Doctors." A. They used us boys in the field who worked at this in the beginning, our experiences, and the laboratory experiences, and they

built this thing up to where it is today. Where we had a $75.00 or $100.00 pump to do our work with, they have pumps today that cost $15,000, $20,000 to build, made out of special alloys.

Mr. Owen: Was it made out of alloys that are not attacked by the acid? A. That is what they tell me. I don't know that part of it.

My notes that I have been referring to in connection with these well treatments, which notes comprise Exhibits 218-A, B, C and D, I had these notes filed away in my office and I had not looked at them until about two weeks ago. About two weeks ago I had occasion to look at these notes when Mr. L. W. Lee came to my house and asked me if I had any records or remembered anything about the acid work that I had done at that time. I told Mr. Lee that I did have some records and I remembered a lot of the acid work I did in those days. Then in a few days Mr. Conner and Mr. Lee came again and asked me again if I had these records. In the meantime I had located the records. I found the records in my office, and no change has been made in these records from the time I found them in my office two or three weeks ago until the time they were brought here into court today. I have had these records and notes in my possession all of this time.

Mr. Lyon: Mr. Sprenger, do you believe you were the first person here in Michigan to go in the acidizing service business, offering acidizing as a service to the well operators, as distinguished from an oil company having its own employees do the work, and buying the acid from somebody? A. We were the first that I have any knowledge of.

Q. At the time you started in the business, so far as you know, the Dow Company had not yet entered into the service business, is that correct? A. No, they hadn't entered into at that time, although we did treat wells on the Grubb farm before I did this work.

Q. Yes. You yourself had done some early work, and that you have reported here? A. Yes.

Q. The point I am getting at is you saw the possibili-

ties, you four men saw the possibilities of this service business, it is your own idea, you didn't copy somebody else, and you started it before anybody else, and Dow came into it afterwards? A. I got my first experience with Dow, from Dow's man.

Q. Doing what? A. Treating the first well.

Q. You bought the acid from them, didn't you? A. Yes.

Q. He came out and showed you how to use it? A. Yes.

Q. But this idea of going into the service business and starting a service company, you were the first with that idea, you four men? A. We were the first that I have any knowledge of doing it.

Q. It was your own idea; it was not suggested to you by somebody else? A. No. I figured it would be a mighty nice business.

The Court: I think while this is right here before me, and I don't close my mind to these things until I decide a lawsuit, but I think I will say on the record that my present impression is that these records are genuine. I don't think they have been made up. I may have asked some questions, I always do, to try and find out things, but I think the records are genuine, in other words, that he made them at or about the time he was treating the wells.

Evidently what he had in mind was whether this acid was going to eat the rock or not and the success of making greater producers. He certainly didn't start out with the idea of how much damage was going to be done to tools, and in spite of the fact he doesn't accept my offered explanation, I am inclined to think it would be a little later that he found out about any damage, that if he did find out was done, and therefore that is to my mind a satisfactory explanation as to why there isn't anything at all about damage in these records he has got.

I think I should add right on there, however, that there not being a word about damage to any of these wells, he depends entirely on his memory, and we can see as to some

of these things, for instance, as to when he began to keep records, and some things, he is quite faulty as to his summary, and this does depend entirely as to the damage and amount of this damage on his memory, and isn't helped in any respect by the record he has made.

REDIRECT EXAMINATION

As I recall the very first well I ever treated with acid was treated on June 3, 1932, for the G-Lee-P Oil Company and the well was the Grubb No. 2. I obtained the acid used in treating this well from The Dow Chemical Company. I would not be positive as to the date of this treatment. It is just from memory. I have no records of this treatment, the records were kept by the G-Lee-P Company. The name of this well was the Grubb No. 2. The acid for this treatment was delivered to our place in wooden kegs and was brought there by Edgar Lee's trucks. Edgar Lee got the acid from The Dow Chemical Company. Prior to that time, June 3, 1932, I had witnessed an oil well being acidized to increase production. My memory on this is kind of hazy and I can't say exactly whose well it was or who made the treatment, but I think it was the Pure Oil Company and they put acid in the well. I didn't know about it and they wouldn't tell me. But I did know that the wells were being treated. All I know about the acid that was used on these treatments by the Pure Oil Company is what I saw on the labels on the acid tanks. They were big labels saying "Caution" and stating that it was very dangerous, to keep away, and the labels bore the name of The Dow Chemical Company. I learned of the treatment of these wells by the Pure Oil Company before I treated the first well for the G-Lee-P Company. I learned of the Pure well being treated along about May of 1932.

FRED CRAMPTON,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

My address is Shepherd, Michigan, and I am superintendent of production for the McClanahan Oil and Gas Company. I have worked for that company since the 22nd of July, 1931. The McClanahan Oil and Gas Company owns wells named the Struble No. 2 and the Schaeffer No. 1. Both of these wells are located in the Greendale Pool, Midland County, Michigan.

The Struble No. 2 well was treated with acid by Dougherty & Markey in the fall of 1932. The production of this well was increased. Its production was around 40 barrels before acidizing and after it produced about 350 barrels in 24 hours. Mr. Sprenger was in charge of introducing the acid into this well when it was acidized by Dougherty & Markey. As a result of putting acid into the well, if I recall correctly, we had trouble with the barrel and, I think, six joints of tubing which would be about 180 feet in length. We noticed that trouble within about 35 days after the treatment when the tubing was pulled because we found we could not get the well to pump. The acid was in there and we couldn't get the well to flowing; and we had to get it to pump and we couldn't get the well to pump right. Then we pulled our tubing and found six loose joints, the bottom six, and that is where we found those threads on the tubing and the barrel to be pitted.

This tubing had been put into the well about six months before and was brand new well tubing. I saw this tubing after it was pulled. I was foreman at the time and I had charge of pulling it, and I examined it after it was taken out of the well. The tubing was not in condition for re-use in the well. We used it for surface pipe on the ground. We were not able to put it back into a well without first rethreading it.

The Schaeffer No. 1 was also treated with acid by Dougherty & Markey. I do not know the date when it was

treated. It was treated in 1932, probably in the fall of that year. As a result of treating this well we got a nice increase. The well was making about 30 barrels when they treated it and for the first two or three days it produced around a thousand barrels, and then of course it dropped off so that within thirty days after treatment it was making around 125 barrels. As a result of acidizing this well some damage resulted, but not to as great an extent as in the Struble well, although we replaced a couple of joints of tubing. Two joints of tubing of about 60 feet were damaged and we did not re-use any of that in a well. The working barrel was pitted and we replaced it when we pulled the tubing.

Dougherty & Markey treated quite a few wells for the McClanahan Oil and Gas Company. I would estimate they treated 15 or 20 wells. The tubing in the Schaeffer No. 1 well before it was treated with acid was new tubing. It had not been in the well hole, I would say, over 30 days. The Schaeffer and Struble wells are the only ones that I recall having any damage done to them as a result of acid treating. With reference to the Schaeffer No. 1 well, we discovered the damage to that well when we put the well to pumping. We would not know of the damage as long as it was flowing. We discovered the damage about 20 days after it was treated.

CROSS EXAMINATION

I would not know to what I should attribute the corrosion of the threads on the bottom sections of the tubing of the Struble and Schaeffer wells, any more than I know that it did happen on these two wells. The corrosion was not caused because the acid was not completely pumped out of the tubing and the working barrel during the operation of acidizing the well. The well started off to flow, but I could not state how long the acid remained in the well.

I would say that there was not much difference in time in the Struble and Schaeffer wells from the time they started to put the acid in until they completed the opera-

tion and we got it to flow. It would be between six and eight hours in all. With modern equipment for acidizing wells, they could now do a better job than that. At the present time those difficulties would be preventable with the type of pump and equipment they now have and with the use of the reverse circulation method.

The ledger book of Dougherty & Markey shows under their account with McClanahan Oil and Gas Company that the first acid job they did for us was on July 27, 1932, when they treated a well with a thousand gallons of acid on the Struble lease. The cost was $250. I remember that job and we got a nice increase in production with no trouble or injury to the well equipment or pipe.

The next acidizing job done by Dougherty & Markey for the McClanahan Oil and Gas Company was on July 30, 1932, when the McClanahan Root No. 1 well was treated with a thousand gallons of acid. I remember that job and we got an increase in production, but I do not remember the exact production figures. We had no trouble with any damage there.

Next, the Struble No. 5 well was treated on August 2, 1932, with a thousand gallons of acid. I remember that job and we got a nice increase without any damage.

Next, the Schaeffer No. 1 well was treated August 9, 1932, with a thousand gallons of acid, and that is the well I previously discussed.

Next, the Struble No. 1 was treated on August 28, 1932. This was a retreatment. The production had gone down and we decided to try again. We did not have any trouble with respect to injuring the tubing the second time, and we got good results out of the second job.

Next, the Schaeffer No. 1 well was treated a second time on September 1, 1932, with a thousand gallons of acid. There was no damage to the well on this second treatment and Dougherty & Markey used the same method of treating it so far as I could tell.

The next acid job done for us by Dougherty & Markey was on September 13, 1932, when they treated one of our wells with a thousand gallons of acid, but I do not know the well name.

Then, on September 16, 1932, they treated another well for us on the Struble lease with a thousand gallons of acid, but I do not know the well name.

On September 25, 1932, they treated a well for us with a thousand gallons of acid, known as the Speardeck No. 1 well. I remember that job, and we got a nice increase in production without any damage.

Again on October 3, 1932, they treated a well for us with a thousand gallons of acid, but I cannot identify the well name.

I do not remember that Dougherty & Markey treated the Schaeffer No. 1 well a third time.

The next treatment made for us was on November 12, 1932, when Dougherty & Markey treated the J. D. Wilhelm well with a thousand gallons of acid. I remember that treatment and we got about the same kind of increase we had gotten with the earlier jobs and had no trouble.

The next treatment was on November 17, 1932, when they treated our Morrison No. 4 well. I remember that treatment. We had a nice increase in production and no trouble to the well.

Mr. Lyon: The increases you were getting in November were about the same as you were getting in July and August with the acid treatment? A. The re-treatment wasn't as large as the first treatment.

Q. But where the first treatment was 1000 gallon treatment, you would get the same results as you did with the 1000 gallon treatments in August and July? A. Yes.

The last treatment appearing in the ledger book of Dougherty & Markey under the heading of wells treated for McClanahan Oil and Gas Company is that of the Wilhelm No. 1 well treated on November 30, 1932. I do not remember that this well was treated twice.

We were pleased with the results of the first treatments in July and August, 1932, and thought that they were worth while.

I am still in the oil business with the same company, namely, McClanahan Oil and Gas Company. I have had other experience with tools being damaged in wells that

came under my personal knowledge besides these two wells I mentioned, but I do not know what kind of acid was used.

I had one other experience of a well being damaged from acid which occurred in either 1934 or 1935. This damage occurred in the Ben Wamsey Well No. 1, located in the Denver Pool, Denver Township, and was treated with acid by Mr. Quinlan. It was a well that had just been drilled by McClanahan Oil and Gas Company. It did not flow, so we put the acid in before we ever tried to operate it. As a result of acidizing the well produced about 150 barrels and is still making about 12 barrels per day. The acid treatment was satisfactory. There was some 500 or 600 feet of well pipe damaged by this treatment. Quinlan had treated other wells for McClanahan but this was the last well he treated for us. We had no damage or trouble with the other wells.

I have experienced damage to three wells as a result of treating them with acid and have had acidized, all told, about 400 wells. My first experience with acidizing wells commences in the fall of 1932, and from that date to the present time, including retreatments, I would estimate that I have had to do with about 2,000 acidizing jobs. The three wells I told about were the only ones I know of which were damaged as a result of acid treating them. Of the 2,000 wells which were acidized, I do not know which proportion were treated with raw acid and which proportion were treated with inhibited acid. They could have put water in and I would not know anything about it. The biggest majority of the 2,000 acid treatments have been made by Dowell Incorporated. They have made about 75 per cent of the treatments.

Quinlan did our acid work for about a year, just how many treatments he made for us I do not know. Halliburton Oil Well Cementing Company has also treated wells for us, but only on about two or three occasions. We experienced no trouble or damage when they treated our wells.

CLIFFORD E. WOLMER,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

I live in North Muskegon, Michigan. I have been in the oil and gas business all my life. I worked for and was interested in the Moline Investment Company, whose business was that of producing oil and who operated in Muskegon County, Michigan. I was superintendent of production for that company and worked for them for nearly ten years.

The Moline Investment Company owned an oil well known as the Charles R. Giles well No. 3 which was located in Muskegon County, Michigan. We had this well treated with acid by Dougherty and Markey in the summer or fall of 1932. This treatment with acid did not increase the production of the well. We had four other wells treated with acid by the same men and the acid treatment would, as a rule, increase their production.

When Dougherty and Markey treated the Charles R. Giles well in 1932, I didn't know enough about the acidizing business at that time to know that there was any inhibitor. We had treated one of our wells before that and the acid had gone down into the well and out through the sand. On this Giles No. 3 well the acid didn't go out through the sand, but it piled up and filled up the hole and Dougherty & Markey didn't have the pump along with them that day to force the acid back, so the acid was left in the well over night. I didn't know what to do and I called them that night and told them that the acid didn't go back. So I tried to get them the next day, and I couldn't get them the next day and I couldn't get them the next day. So my only hope was, to save the casing and tubing from eating up and ruining the well, to pump water in there, and I pumped water in that well with an old boiler I had on the lease with a donkey pump. I pumped water in there

for about twenty-four hours and let it flow out in a slush pit. But I didn't want to ruin the well. That was the idea. Well, I couldn't get hold of Dougherty and Markey, so I pulled the tubing out. I had the tubing pulled out of it. When I pulled the tubing out, part of it came out and part of it didn't come out. It was eaten out in such a way that it left part of it in there, so when I went to pull it up, why, it dropped back.

So I pulled the tubing out there and laid it out—there was between four and five hundred feet of that tubing that was eaten up so bad by acid I couldn't put it back into the well, so I got Mr. Dougherty, he came over to see me, and I left it out. He says, "What is the trouble?" "Well," I says, "Come out and see." Well, we went out there. He says, "That tubing is eaten up pretty badly." "Yes," I says, "Dougherty, I am afraid of that casing, but the tubing is all eaten up." I says to Dougherty, "I am going to sue you for the loss of that well," which was making quite a little oil. "No," he says, "don't do that, Wolmer," he said, "We will fix everything all right." "Well," I says, "you treated that well with an acid without an inhibitor in it, didn't you?" "Well," he says, "I guess we did." He admitted the truth. And so he said, "Now, Wolmer," he says, "we don't want no trouble over this," he says, "at all." He says, "We want to fix this well up as good as it was before, and," he says, "we won't have any trouble with you at all."

But he furnished the tubing. I think he furnished four or five hundred feet of tubing. I don't just remember how much. And I run it back in there, in the well, and the casing was not eaten up. There was mud back of the casing which would hold any holes that there might be in there, and the $6\frac{5}{8}$ bottom string of casing was mud, if it was, and I never saw the bottom of that casing, to know how bad it was eaten up, but the tubing was eaten up. Dougherty and Markey gave me a new tubing as a result of that.

The Court: Well, you had to fish out your tubing. A. Well, we moved a drilling machine in there, and we tried to fish it out, but we couldn't get hold of it. Well, there

was a portion of the pipe that we couldn't get anything to fish it out with. So we put on a bit the full size of the hole and drove it down to the bottom, and it drove right down, just drove right down. That acid will take all the life out of tubing or anything that is iron or steel. We drove it down there, and later we had the well treated with acid with an inhibitor, and that was very satisfactory, and we got very wonderful results.

The Court: Who treated it? A. Well, it was a man working for the Dow Chemical Company. I am not sure whether he was under Dow Chemical Company. He had a contract. His name was Quinlan. He treated the well and the production was very good after that.

CROSS EXAMINATION

The Charles R. Giles well No. 3 is the only well that Dougherty & Markey ever treated for the Moline Investment Company. There was about 400 feet of tubing that had to be replaced in the Charles R. Giles well and it was worth about 30 cents a foot. Dougherty and Markey replaced the tubing. I have never had any other trouble with working barrels having to be replaced after an acidizing job.

The Moline Investment Company had five wells acidized and that is all. The Muskegon Oil Corporation acidized one of these wells and I think a man named Quinlan did the rest of them, as I remember it. This was about nine years ago. The Muskegon Oil Corporation acidized one of these wells early in the summer of 1932. I did not ask them where they got the acid and I do not know whether it was inhibited or not. I think a Mr. Howard did this work for the Muskegon Oil Corporation. I do not know where he got the acid. I didn't ask any questions. The acid was all new to me at that time, and I knew it would help the wells and we were just in the place where we had to have some help.

Mr. Lyon: The reason you had this trouble on the Giles well was because they couldn't get the acid out of the pipe, and they didn't have any pumps there, and they let it

stay in the pipe too long, was that it? A. Well, there wasn't any inhibitor in it.

Q. Well, I mean they didn't get the acid out of the pipe? A. Yes. There wasn't any inhibitor in it and the acid didn't go out through the oil sand.

Q. They didn't have any pumps to pump it out? A. That is right.

Q. So the acid stayed in the pipe longer than it was supposed to, didn't it? A. Yes.

Q. How deep was that well? A. About 2,020 or 2,030 feet.

Q. And how long had the tubing been in the well when you acidized it? A. Well, let's see. That was 1932. About between three and four years.

MILFRED WELLS,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

I live at Zeeland, Michigan, and my business is that of contractor and producer. I am in the oil business and contract to drill wells. I have been in this business ever since 1926, and have drilled and produced oil wells.

In 1932 I was associated with a man named R. D. Malcolm in the venture of drilling an oil well. This was

a sort of partnership or company and we operated under the name of R. D. Malcolm. We owned a well known as the Hastings No. 1 which was located in the Greendale Pool, Michigan. This well was drilled in some time in July of 1932, and was treated with acid to increase its production by Dougherty and Markey. The acid treatment to the well helped its production to the extent that before the treatment the well was making about 30 barrels of oil and after acidizing it made about 90 barrels. As a result of putting the acid into this well, we had some corrosion trouble. We had some 200 or 300 feet of tubing that was eaten up. About two or three weeks after the well was treated with acid, I helped pull the tubing out of the well, and I saw it after it was removed from the well. The bottom of the tubing and the threads on the tubing were eaten up, and we did not put it back into the well, but used it for line pipe on the surface of the ground. The tubing was in such shape that we could not put it back in the well and use it. We wondered how we got it out of the hole. I do not remember Dougherty and Markey treating any other wells for us. But they gave us a retreatment job on that. They may have treated other wells for us, but I do not recall.

As a result of the damage to this well, Dougherty and Markey made a settlement with us by giving us a free acid treatment and they rethreaded the pipe for us, but we did not put it back into the well. We just rethreaded it and used it on the surface. When they gave us a free acid treatment by way of settlement, I do not know whether it was the same kind of acid or not. We had no damage to the well as a result of the retreatment.

CROSS EXAMINATION

Mr. R. D. Malcolm was my partner on this job.

(The witness was shown a ledger book (PX-213) of Dougherty and Markey and his attention called to the account therein carried under the name of "R. D. Malcolm," bearing the entry under the date of October 4, 1932, as follows: "1000 gallon shot, Hastings No. 1, $175.")

Mr. Lyon: Is that probably the account for the job that you have been telling us about? A. I think it was not in October. The first treatment that he gave us was in July.

I do not remember just when they gave us the retreatment, but I know it was along in July some time. I do not know who paid Dougherty and Markey the $175 by check for the acid treatment performed for R. D. Malcolm on October 24, 1932. I didn't write any checks. Mr. Malcolm wrote the checks. I have no way of fixing the date of the acid treatment I refer to without getting it from Mr. Malcolm. He kept the books and everything. I do not know where the acid came from that Dougherty and Markey used in treating the Hastings No. 1 well for R. D. Malcolm.

JAMES R. LEWIS,

a witness called by plaintiff, testified as follows:

DIRECT EXAMINATION

My name is James R. Lewis. I live at Houston, Texas. I am employed by the United States Department of the Interior in an investigative capacity, and have worked for the Department of the Interior just less than eight years, a few months. I am engaged in so-called enforcement work of the Connally Hot Oil Act.

I had occasion to do work of an investigational nature

for Dow Chemical Company or Dowell Incorporated during the period of July and August, 1939, while I was on leave or furlough from my regular duties that I have just explained. That work took place largely in West Texas and particularly in the vicinity of Odessa, Texas. The nature of the investigation and the instructions that I attempted to carry out was to determine, if possible, whether or not the Chemical Process Company, whose principal place of business was at Odessa, Texas, were using any one of several different metals or other substances in their acid trucks. I had occasion to inspect quite a number of the acid trucks of the Chemical Process in that territory, some fifteen or eighteen altogether, I should say.

Mr. Conner: Now, will you please tell the court what, if anything, you learned during that period about the structure of the tanks of the Chemical Process Company with particular respect to the interior of those tanks? A. The tanks that I observed were of sheet metal construction—I judge steel or some steel alloy. They were more or less of a circular or oblong shape, would hold varying amounts of fluid anywhere from, I should say—this is just an estimate—I should say in the neighborhood of 1000 gallons. and each one of them had at the top and near the back of that tank an entrance frequently referred to as a manhole that could be manipulated, opened or closed; most of those holes were large enough that a man could pass through the entrance to the inside of the tank, if so desired. I inspected the interior of a number of those tanks; probably eight or ten, or more, of those tanks were examined by myself during that time.

Q. Did you have occasion during this period of July and August to see the Chemical Process treat any wells with an acid? A. Yes, I did. I went with them on a number of occasions from Odessa, where they loaded the tanks with the acid solution, to the well locations, in certain instances.

The Court: How did you arrange to do that? A. The driver of one of the trucks I made friends with. He, of

course, didn't know my object in making the trips. I didn't explain to him the real object of it but told him I was interested in learning as much as I could about the manner of treating these wells and the effects obtained. I was invited to go with them.

The Court: You weren't employed by any of those people down there? A. No, sir, not at all.

Mr. Conner: Did you on any occasion see the Chemical Process treat any wells with acid? A. Yes, I did. I saw them treat 5 or 6 wells, I should say, during that time.

Q. Can you recall at this date whether or not any of the tanks, the interiors of which you inspected, were any of the tanks that you actually saw at the well site when Chemical Process was treating the well with acid? A. Oh, yes, yes, a number of them.

Q. Did you ever have occasion to examine at very close hand the interior of any of these steel tanks of the Chemical Process Company to ascertain whether or not there was any metal other than the bottom of the tank in those tanks? A. Yes, sir, I did. That was the principal object of my going to these wells, was really to ascertain, if possible, what, if anything, was on the inside of those tanks, and when the tanks would be pumping their contents into the well I would be standing on the runway—there is a runway, Your Honor, that is a part of the truck equipment on which you can stand, and you could look into that manhole. It would be open, naturally, to let the air come in as the fluid was withdrawn. And I stood there on each of those trucks and watched them unload in that way, and saw everything I could.

Q. What, if anything, could you tell by these observations as to whether or not there was any metal in those tanks other than the bottom metal piece of the tank? A. Well, in some instances I couldn't see anything other than that. But in other instances I saw certain objects, not a part of the tank itself, lying in the bottom of the tank.

Q. Did you have occasion to examine very critically and at very close hand, such as being in these tanks, to

determine whether there was any metal other than the bottom part of the tank in those Chemical Process tanks? A. Yes, I did. I could not, of course, enter the tanks while they were in the operation right there. I could see in some instances material in the bottom there which appeared to be lead. I couldn't absolutely say that it was, because I didn't have my hands on it, although I was as close from where I am sitting, almost close enough that I could reach it, but those same tanks, later, after they were put back in the company garage in Odessa, I had occasion to examine that material very closely.

Q. Did you ever obtain any samples of that material? A. Yes, sir; I did.

Mr. Conner: I ask that that piece of lead be marked as PX-317 and the tag as PX-317-A.

(The articles referred to were thereupon marked PX-317 and 317-A.)

Mr. Conner: Mr. Lewis, I show you a piece of lead, or what appears to be a piece of lead, and ask you if you have ever seen it before? A. Yes, sir; I have. I can identify it by virtue of certain inscriptions that were placed on that piece of lead by myself. Right near the top, beginning is the date 7-24-39, which indicated the date that this sample was obtained. And underneath that is the word "Truck No. 65." Underneath that is the license number, which is 60-814. That was a Texas license number. And underneath that are the initials "C. P. Co." which was to stand for the name of the company, Chemical Process Company. And the last part of the inscription is my own initials, J. R. L. That inscription was put on there by me the night of July the 24th, 1939, or the early morning hours, possibly, of the morning of the 25th.

Q. And you obtained that sample from the tank and license truck as indicated? A. I did.

Q. I hand you PX-317-A and ask you if you can identify and tell what it is, and please read it. A. Yes, sir; I can identify this card. It is a card that I myself wrote certain notations on, with reference to the sample

you just handed me, sample of lead. It is in my handwriting. I will read it. (Reading):

"This sample is a piece of sheet lead about 3/32 of an inch by 4 inches by 9 inches that was taken by me from the roll of the same material found in truck tank of Chemical Process truck No. 65, Texas License No. 60-814 at about 12:00 o'clock midnight on the night of July the 24th, 1939. The tank was about ½ filled with water and was sitting in what appeared to be a repair shop of the Chemical Process Company at Odessa. This truck delivered acid to an unknown well that day.

"Signed J. R. Lewis."

Q. Does this identifying card have any indication as to the size of the lead plate from which this sample was taken? A. There is no comment on the identification tag about that size, but stating from memory there was a considerable roll of this material; it had been in the form of a sheet, apparently, originally, and it had simply been rolled up and just dropped into the bottom of the tank, apparently. It appeared to have been eaten away quite a good deal at that time, as will be indicated by the sample. I should judge that the roll of lead, at the time I observed it, would possibly weigh 20 or 30 pounds, in that instance.

Mr. Conner: I ask that the reporter mark the second sheet of lead as PX-318, and the identifying card as PX-318-A.

(The sheet of lead referred to was marked PX-318, and the card referred to was marked PX-318-A.)

Mr. Conner: I hand the witness what appears to be a piece of metal and ask if it likewise came from any tank of the Chemical Process, and if so can he tell us from what tank? A. Yes, I recognize this piece of material as a piece of what appears to be lead obtained by me from another of the Chemical Process Company tanks at Odessa on the night of July 25, 1939. I identify this by an inscription placed on it in my own handwriting, "July 25, 1939." Underneath is "No. 60-815," the latter number identifying the Texas license number of the truck from which the sample was obtained.

Q. I hand the witness PX-318-A and ask him to state what it is and what connection it has with PX-318, if any? A. This is an identification card bearing an inscription in my own handwriting that I attached to the sample at the time the sample was obtained, and the notation on this card reads:

"This sample is a piece of sheet lead about 3/32nds of an inch by 3 inches by 6 inches that was taken from a large piece about 28 inches by 36 inches by 3/32nds of an inch found in the bottom of Chemical Process Company truck tank about 2:30 A.M. on the morning of July 26, 1939."

I think that occurred in this way, I marked the lead as soon as I got back where I could, and the identifying tag was written the following morning after daylight, and that is the reason for the difference in the two dates.

"The truck has Texas license number 60-815 and was the same truck that was one of seven delivering acid to Texas County Well No. 1-D, Mallet Land & Cattle Company Labor 15, League 52, Hockley Co., on July 24, 1939, at which time I observed it to have lead in the tank. Signed J. R. Lewis."

The Court: I understood you had seven of those tanks for one well? A. Yes, sir.

Mr. Conner: I call the witness' attention to the inscription that is on the reverse side of the last lead plate and ask if he knows what that inscription is, or if he had anything to do with it. A. There is an inscription on the opposite side of the lead from which I read a moment ago, two, as a matter of fact, both of them reading "T-6"; that is an inscription that I had nothing to do with and have no knowledge as to what it indicates.

Mr. Conner: I will state for the record that that inscription "T-6" was my own inscription for the purpose of keeping track of some samples I had.

I ask the reporter to mark the third lead plate as PX-319, and the accompanying tag as PX-319-A.

(The sheet of lead referred to was marked PX-319, and the tag referred to was marked PX-319-A.)

Mr. Conner: I hand the witness PX-319, comprising what appears to be a piece of lead plate, and ask if he can identify it, and if so how? A. I can identify it not only because of the inscription that appears on it in my handwriting, but because I remember the particular piece of lead quite well. The inscription is dated August 11, '39, truck 77, license 60-818, trailer license No. 12-574. Initialed J. R. L.—my own.

Q. Is that the piece of lead that you obtained from a tank of the Chemical Process Company? A. Yes, sir, I obtained that piece of material from the tank on Chemical Process Company's truck No. 77, which bore Texas license number 60-818, and a Texas trailer license number 12-574.

Q. I hand the witness PX-319-A and ask if he can identify it. A. Yes, sir, this is the identifying card on which I made a notation at the time that sample was taken, or shortly thereafter. The notation reads:

"This sample is a piece of sheet metal, apparently lead, on which I have inscribed the date of August 11, '39, truck No. 77, and other data to identify it. It was cut by me from a large roll of similar material found inside tank on Chemical Process Company truck No. 77, Texas license number 60-818, trailer No. 12-574, at about midnight, August 11, '39, while truck stood half full of oil coated water at the company garage. J. R. Lewis."

Q. Have you any recollection at this time as to the size of the piece of lead from which you cut the lead represented in PX-319? A. Very distinctly, yes. The size of that, that was the largest of all of these that I examined, it apparently was a nearly new roll; it had not been eaten away very much, as is shown by the sample itself. In my best judgment, the length of that roll was perhaps 28 to 32 inches. It was under water, of course, and I can only estimate it, I did not measure it; and in circumference it was perhaps 10 or 11 or 12 inches in circumference, and apparently had been rolled about once and a half or two times, from which in my—I estimated from those characteristics that spread out it would probably be a sheet of lead about

28 or 30 inches square, and perhaps 3/32nds of an inch thick, more or less.

Q. After obtaining these pieces of lead represented by PX-317, 318 and 319, what did you do with them? A. I marked them as has already been shown, and thereafter I either gave them to you personally at a meeting between us in Amarillo, Texas, or I may have mailed one or more of them to you at Tulsa, Oklahoma.

CROSS EXAMINATION

By Mr. Lyon:

Q. Did you go to the well on these occasions on the truck with the driver? A. In some instances I did, yes, sir, and in a few instances I drove my own car.

Q. Did you keep any record of this investigation? A. Well, I made certain notes and reports almost every day to Mr. Conner there, but I mailed those in to him.

(These reports were produced later and submitted to defendant's counsel.)

Q. How did you get invited by, or arrange with the driver to let you ride on those trucks of the Chemical Process Company? A. Just as I explained a little bit ago, I simply indicated to them that I was interested in learning the manner in which they treated these wells, and what effects were obtained by the treatment.

Q. What was the driver's name? A. One of them is all I remember, one of them was a Mr. Jackson.

Q. What was his first name? A. I don't happen to know at this time. They called him "Jack."

Q. Is he the only driver that you rode with, that you ever rode out with. A. I believe he is the only one I actually rode with. Of course there were others.

Q. What did he look like? A. Oh, he was a large man; he would weigh about, perhaps 180 pounds; I judge him to be about 33 or 34 years old, dark-complexioned, a very good looking man.

The Court: How did you get in there and cut that lead off? A. I had a pair of large tin snips, Your Honor.

The Court: Well, was it right near the manhole? A. No, sir. That last piece there, that is the reason I remember that one so well. It was clear up in front of the truck, and I had to crawl in there and even get down underneath the water and pass under a partition in the middle of the tank before I ever succeeded in finding the lead at all.

The Court: How much is lead worth a pound? A. In that last roll there, which was apparently a new roll, I would judge that roll to have at least a hundred pounds in it.

The Court: How much is it worth a pound? A. I have no idea.

The Court: How much did you cut off, all told? A. Those were the approximate sizes of the pieces.

The Court: How many pieces did you take from this company? A. Only those three. Those are the only three pieces of lead that I recall obtaining.

The Court: Inside a building? A. Inside an open garage; yes, sir.

The Court: Did you see any trucks that didn't have any in? A. Yes, sir. I saw some trucks that I couldn't see any in from the outside. I wasn't on the inside of any truck that I didn't find lead in.

The Court: And you were—you only got into three trucks? A. I believe so, yes, sir.

Mr. Lyon: How many trucks did they have? A. They had—there are stationed at Odessa eight or ten, perhaps more than that, but they had another base over in New Mexico and sometimes the trucks from New Mexico would come over to some of the Texas wells.

Q. Did you look in these other trucks? A. Yes, sir. I looked at every one I got a chance to.

Q. Did you look in all of them? A. I wouldn't say that I did, because there are some of them that I may not have had a chance to look in.

Q. How many of them did you look into? A. I would say I looked in at least ten.

Q. In these three that you found the lead that you

took the samples from, was that lead just in there loosely, or was it attached to something? A. Didn't appear to be attached to anything; just lying in the bottom of the tank.

Q. Just rolling around in there? A. It wasn't rolling very much, because the roll wasn't completely round. It was somewhat oblong and I imagine it would slide, but I hardly think it would roll very much.

Q. Now, you said that in these samples that weigh about twenty pounds—one of these rolls had about twenty pounds. A. That was in the first truck, yes.

Q. Just show us with your hands about how big a roll that was? A. Well, it was a roll, I would say, closely approximating the little machine sitting on the reporter's desk there. It was not a solid body, you understand, but it was rolled to where the over-all dimensions would roughly approximate that little machine.

Q. And was it rolled up in a spiral? A. Yes, sir.

Q. How many rolls of it? A. Well, I would say one and a half to two turns in the spiral.

Q. Now, did you notice whether or not there was any connection made between these tanks and the casing in the—or the piping in the well when the cementing operation went ahead? A. Yes, sir, I saw a number of the tanks hooked up by portable connections.

Q. I mean, did they have any wire to connect the tank, or any cable to connect the tank to the pipe? A. Well, I am not certain that I understand the question. Do you mean some kind of cable through which fluid would pass?

Q. No, like a cable to carry electric current? A. I didn't see any such cable as that. I heard some comment about it. I looked as far as opportunity was afforded but I didn't see any.

My instructions for making this investigation were oral. Mr. Conner gave them to me and I made reports to Mr. Conner. They were not extensive reports. They were more or less just informal memorandum reports. I did not report every day. If there was nothing to report no report was made; during that period of time, oh, perhaps a dozen

letters written. This is the only investigation I ever made for the Dow Company or for Mr. Conner.

The Court: Just this one job at Odessa? A. That is right. I wasn't at Odessa exclusively in this particular job but there most of the time, and it's the only one I did for them.

Q. Where else did you go? A. Well, I was at Breckenridge.

Q. What did you find at Breckenridge? A. I only stayed there part of one day. I merely found some storage tanks out there. I don't know what they had in them but nothing of any significance, in my judgment, was laying there.

Q. Where were they? A. They were down in a section of the town sitting near the railroad tracks, Your Honor.

Q. Why didn't you crawl in them? A. Well, those tanks, in the first place it was in daylight, and they were plainly exposed to view; and in the second place, if they had acid in them you couldn't do it.

Q. Well, was there acid in them? A. I don't know.

Q. Why didn't you go at night and find out? A. Because I had been instructed that most of the expected results were to be obtained at Odessa.

Q. What did you go there at all for, then? A. Breckenridge happened to be the home town of the owners of the Chemical Process Company.

Q. It's just as much night there as it is any place else, isn't it? Get just as dark? A. That's true, but Breckenridge was right enroute between Tulsa and Odessa anyway. I was instructed as I passed through there to look over the situation and see if anything that appeared to be of interest—

The Court (interrupting): Did you make out a bill for your services? A. I don't believe I did. I made out some expense accounts. I don't believe I made any bill other than that.

Q. And they would give you your expenses, wouldn't they? A. Yes.

Q. Who gave you your furlough? How was that arranged? A. Arranged by my superior in Washington.

Q. Did you get that as a result of this employment? Did you plan as your vacation to get this employment because you had secured the employment? A. The circumstances were these—I hadn't had a vacation in nearly five years in Government service. I was going to take leave anyway. I discussed with my superior in Washington the possibility that I might secure or accept a permanent employment with The Dow Chemical Company. I wasn't certain whether I would like the employment or not in any event, or whether it would be offered in any event. He very graciously permitted me to have the opportunity of going out and undertaking this one assignment with the view that if I liked the employment and it represented advantages to me that I would sever my connections with the Government. And, on the other hand, if I wanted to come back, my job would be waiting for me when I came back.

Q. Where were you when you made this arrangement? A. In Washington at the time.

Q. What were you there for? A. In connection with some cases for which I had been called to Washington for a conference.

Q. Anything in writing about your furlough at all? A. I am sure there is, Your Honor.

Q. Didn't you get any letters about it or write any letters about it? A. Yes, sir, I wrote some letters to my superiors forecasting this possibility.

(The correspondence between Mr. Lewis and his superiors was later produced and submitted to the court.)

Mr. Lyon: Do you have a Government badge? A. Well, I don't have a badge, I have an identification card. I have never had a badge.

Q. Did you use that identification card at all in connection with making any contacts with the Chemical Process Company's men? A. Not whatever.

Q. How did you make your contacts? A. Simply by word of mouth.

Q. Well, were you given permission to go into their garage at night and crawl inside their trucks and cut off pieces of lead out of their tanks? A. No, sir.

Q. They didn't know you were doing it? A. I don't think so.

Q. When you rode out to the well did you tell them you were interested in whether or not they had anything in their tanks? A. Yes, sir, but I didn't tell them why I was interested.

Q. Did you ride out with more than one driver? A. I don't think I ever rode with any one except Mr. Jackson.

Q. How many trips did you make with him? A. I think as many as two, maybe more than that; I would say not less than two, though.

Q. Not less than two, it could be only two less than two; how many did you make, or don't you know? A. No, sir, I don't know how many times I rode with Mr. Jackson.

Q. How many wells did you go out to? A. Well, I went to several; I remember the one up on the Mallet Land & Cattle Company very well, I remember going to two different locations down in Upton County, and I remember going to one, and perhaps two, on the Gulf leases right on west of Odessa, I have forgotten the name of the leases out there.

Q. Did you ride on the Chemical Process truck? A. No, sir, I think I went with my own car all of those times except that I believe I rode with Mr. Jackson when I went up to the Mallet Land & Cattle Company, and it is my recollection that I rode on one other occasion with him, but I can't say at this time which of the other occasions it was.

Q. Did you give Mr. Jackson your name? A. I gave him a name, yes, sir, I didn't give him my—

Q. Did you give him your same name you have given in court? A. No, sir.

Q. What name did you give him? A. I told him my name was Paul Jackson.

Q. His name was Jackson, wasn't it? A. It just happened, that was one of the bases of friendship.

Q. Where did you tell him you were from? A. I told him I was from Kansas, as I recall.

Q. Were you from Kansas? A. I had been in Kansas.

Q. Were you at that time? A. No, sir, I was not in Kansas right at that time.

Q. Did you meet anybody else connected with the Chemical Process Company there in Odessa except Mr. Jackson? A. Yes, sir, not to say meet them, I wasn't formally introduced to anybody else, I don't believe.

Q. Did you give your name to any other representative of Chemical Process Company? A. Well, I didn't give it to them, but I was known among all of the men that worked with Mr. Jackson there, I was known, if known at all I was known as Paul Jackson.

Q. Now, can you name some of the other men that knew you by that name at that time? A. No, sir, I couldn't, because I don't remember the names of anybody else there.

Q. How many other men did you meet, if you met any? A. Well, I didn't meet any of them formally, as I said, but I think there were seven or eight other men there that I had a speaking acquaintance with.

Q. You didn't make any arrangements with the people to let you hang around watching what they were doing? A. Not other than what I have told you; they seemed to be entirely willing to permit me to do so; of course I made—

Q. They didn't seem to be trying to hide anything or keep any secret? A. Well, I couldn't answer that just that way. If you want to know what it seemed to be, I will be glad to tell you.

Q. I am trying to find out from you on what pretext they would allow you to stay there if they were trying to cover anything up. What pretext did you use? A. Well, the pretext that I used was just as I have stated, I told them that I was interested in learning all I could about treating wells and that I knew nothing about it and it was more or less a new undertaking, apparently, in the oil business, and apparently, very excellent results were being obtained, and that I certainly wanted to know all I could about it.

The Court: Have you ever done any of this kind of work before? A. No, sir. I had worked for a unit of the Standard Oil Company there, but was an accountant more or less by profession at that time.

Mr. Lyon: That investigation that you made in July and August of 1939 for Mr. Conner and the Dow people, is that the only investigation that you have ever made outside of your work for the Department of the Interior? A. Well, I have worked with various state agencies a good many times.

Q. This is the only private work that you have done? A. Yes, that is right. The only private investigation that I have made.

Q. Did you investigate anything or anyone aside from the Chemical Process Company? A. Only very nominally; I made some casual inspections of the facilities of Mr. Beard, I think it was, down in McCamey, Texas, and I made some examinations of some of the Halliburton activities during this same time.

Q. Did you crawl into any of the Halliburton tanks? A. No, sir.

Q. And cut off any pieces of anything? A. No, sir. I was never on the Halliburton property, I was never upon any of those tanks, or where you treated a well. I merely went up where they had their business, where they kept their trucks and stored their acid, and so forth, where they kept their trucks stored and their acid stored; I was up there a good many times and observed the truck movements, but that was as close as I ever got to any of the Halliburton activities.

Q. Was that at the request of Mr. Conner? A. Along the lines of his general instructions.

REDIRECT EXAMINATION

Mr. Conner: Last Friday we had Mr. Lewis on the stand, and I will recall him and have him show you what correspondence he has relative to his leave of absence from

the Government to do the temporary work he did in July and August of 1939 for the Dow Chemical Company.

Mr. Conner: Mr. Lewis, will you please show to the court whatever corresponce it was that the court asked for, relative to the leave of absence that you obtained from your agency in 1939? A. Yes, sir.

(The witness exhibited a file of correspondence to the court, and the court examined the file.)

The Court: I have looked at the correspondence between the witness and his superior and Mr. Conner up to the time the leave was granted. It is quite a file. I have not looked at the balance of it, which he says was with Mr. Conner. I will just say this on the record, that the portion I read seems to fully corroborate what the witness said about the leave he obtained, it seems to be regular and proper, and the leave seems to have been a regular and proper leave. I do not see anything to criticize in the way that he obtained his leave, and the way it was granted. It all seems entirely regular. But I have not looked at the other part. Counsel may look at the balance if they desire. I have not. I do not know what he has written back and forth to Mr. Conner, because, as I say, I did not go into that. He has a big file there about it. It often happens that it is better to show things than not to, because they look better when you see them than they do when you use your imagination.

Mr. Conner: I have my file here, which is my correspondence with Mr. Lewis and his reports to me, which I will submit to counsel.

The Court: I think that you have fully complied with my request, and I will say that that part of it does not look bad at all. It is all regular and proper, as far as I can see. The man is ambitious, and wants to work. I am not discussing any of his relations with you at all, but so far as his obtaining his leave of absence, and he is very frank in what he said about getting it, and they were very frank, that he was entitled to the leave of absence and got it; and he was entitled to do what he wanted to do when he was on

leave. So there is nothing that reflects on the witness or the Department. It is all regular in every way.

Mr. Lyon: May I see both files?

Mr. Conner: You can see both files. I have no objection to the defendant seeing Mr. Lewis' file. I am saying now I have seen that, and I think this is a much more complete file, and this letter here, I think (indicating) is the one you were looking for. There were some acid samples.

(Mr. Conner hands file to Mr. Lyon.)

Mr. Conner: Your Honor, Mr. Lewis has produced his file at Mr. Lyon's request. I have asked Mr. Lewis to take out of his file some three letters here (handing same to the court) which have nothing to do with reports he made to me. They are somewhat in the form of personal letters. I have no objection to your seeing them. But, specifically, they have to do with a man we hired later, and I do not care to have his identity disclosed, but I am, of course, only too glad to have you look at the letters and determine their relevancy.

The Court: This is something you took out of your file?

Mr. Conner: No, sir; they came from Mr. Lewis' file.

The Court: I haven't read those; I am thinking about it.

Mr. Conner: I have copies of some of those which I took out of my file, too; yes. These are letters written afterwards, after this gentleman left our service, and I am asking him by mail or by phone or what not, we had two or three letters back and forth, where we were discussing certain people I had intended to hire, and I did hire one of them later, and it has nothing to do with these samples that Lewis obtained in this month of July 15 or July 13 to August 15, and I don't care to have these fall into the hands of defendant unless the court thinks it is material to this case.

The Court: Are they in chronological order here? A. The one in longhand is Mr. Conner's letter.

The Court: Well, to sum that all up, all it amounts to,

it suggests a name to carry on his work. That is what it gets down to; it would reveal the name of somebody that is recommended.

Mr. Conner: I think there are two men mentioned in there and one of them we did hire.

The Court: That is the only object, isn't it? I don't see as that would have anything to do with the other; it is a discussion about whether or not he would accept what you offered him for the future to leave the Government service and take up work for the Dow Company, but the only thing they object to, and the only thing it would add to what you already know is the names of those parties, and I cannot see any relevancy.

Mr. Lyon: I have two files here, one which was handed me by the witness and one which was handed me by Mr. Conner. Is the file you gave me your complete file of all your correspondence and reports on this matter so far as you have them? A. Yes, sir, that is true.

Mr. Lyon: And is the same thing true of your file, Mr. Conner, or has something been taken out of it?

The Court: There were two letters in here, copies of letters you had written, or somebody? A. That is right, they are merely extra copies, Your Honor.

The Court: Then they are complete except—that (indicating) didn't come out of your file, did it? A. Yes, sir.

The Court: The longhand letter came out of your file? A. The longhand letter came out of my file, that was his longhand letter to me.

The Court: And your reply to him? A. That is right.

The Court: That is all that are out of your file? A. That is right.

The Court: I have already told you what they were; I have told you everything except the names of those two men, and they do not mean anything to me, but that is all the added information you would get out of reading that from what you now know.

Mr. Conner: Mr. Lyon asked me if my file is complete on my correspondence with Mr. Lewis. It is, with the ex-

ception of these letters I have taken out (indicating). This I think you have seen the copies of, and this longhand letter, the original of it, I don't know whether you have seen this or not (handing documents to the court).

The Court: No, I haven't.

Mr. Conner: But it is in longhand on the same subject, and with that reservation my file is complete.

The Court: Well, that longhand letter by you to Mr. Conner, as I understand it, doesn't discuss this same man, or is that another man? Is that the same man?

Mr. Conner: I don't remember, I believe it does.

Mr. Lyon: This correspondence, Your Honor, in both of these files is in longhand. It is not typed, and I am unable to check one file against the other. For instance, I find in Mr. Conner's file copies of letters and apparently copies of letters to Mr. Lewis that I do not find in Mr. Lewis' file.

Mr. Conner: I cannot explain that. It is in longhand writing because I do practically all of my work in longhand, and once in a while I get it typed, but I am old-fashioned.

Mr. Lyon: For instance, Mr. Conner, the top letter in your file, one of the top ones, is dated September 22nd to Mr. Lewis, and I do not find it in Mr. Lewis' file.

Mr. Conner: This letter of September 22nd in longhand to Mr. Lewis is an original pencil letter which I sent to Mr. Lewis and at the time of sending it I retained the carbon copy of this longhand letter dated similarly, and I asked Mr. Lewis certain questions which he answers herein, as indicated by the red ink notations, so this letter, the original in pencil, went to Mr. Lewis; I retained the copy which you see here, and this, the original letter, (indicating) he sent back to me by way of answering my letter, putting those notations on it.

Mr. Lyon: Well, you evidently had been just—just glancing through this correspondence in a hurry, you evidently had considerable trouble in obtaining samples at the wells of the truck acid, is that correct? A. Well, not exactly trouble, no, sir; we had some difficulty in getting samples from each of the different trucks; we didn't have any dif-

ficulty getting some samples, but the difficulty was in getting it from the different trucks.

Mr. Lyon: Then after you had gotten them and sent them to Mr. Conner, or up to his company, it appeared that there was some confusion as to which samples came from which trucks? A. Well, that was particularly true with reference to one sample obtained by my man Lane.

Mr. Lyon: Now, you didn't tell us the other day, but it appears from this correspondence, that the Chemical Process Company were using rubber-lined transportation trucks? A. They had one truck that was rubber-lined; I didn't tell you about it; nobody asked me about it.

Q. And you took samples from that truck and forwarded those? A. Nearly all the samples obtained were from that truck. I wouldn't say that they all were but you asked me if there was any I don't think the question was ever answered but you asked me if there was an attempt made by any one to conceal anything at the wells there. The fact is every time they gave us a sample, with the exception of maybe once or twice, it came from the rubber-lined truck.

Mr. Conner: You mean the acid samples? A. That is right. Acid samples.

Mr. Lyon: Well, Your Honor, I don't like to hold this up while I study these files. If the files could be available, if there is any further evidence on this matter, why that would satisfy me.

The Court: I will put this on the record—that this gentleman left the service of Dow before he completed his work. I got that from what I read. That he terminated his employment with Dow before he completed all they wanted him to do because the Government needed him, and the time had arrived when he had to go back to work. That grew into his recommending this other man.

Mr. Conner: I don't believe Mr. Lyon will mind my stating on the record that Mr. Lewis' expense account shows the first date of July 14th and ran through August 14th. And that was the period that he was in our employment, and we paid him for one month.

JAMES W. REBBECK,

a witness called in rebuttal by plaintiff, testified as follows:

DIRECT EXAMINATION

Mr. Owen: Have you prepared a chart which shows the different acids that are corrosive to iron or steel, and also other data regarding the materials called for in the Gravell patent? A. Yes, sir, I have.

Mr. Owen: I will offer this chart in evidence as PX-337.

(The chart referred to was thereupon marked PX-337.)

The Court: Taking the Gravell patent for what it says and what it claims, it seems to cover any kind of a material that you put in that will put a coating on the iron and protect it against corrosion, doesn't it, to take in what it tried to cover.

Mr. Owen: I believe that is true, Your Honor.

The Court: And, again, right over, if used in a container for storing or transporting?

Mr. Owen: Correct.

The Court: I go right over to the Grebe patent, and that attempts to cover any kind of an inhibitor that will prevent acid eating iron if used in acidizing a well.

Mr. Owen: That is right. That is, if used in hydrochloric acid.

The Court: In hydrochloric acid.

Mr. Owen: And some of the claims are not as broad as that, because they call for—

The Court (interposing): And, in the broad sense, anything that inhibits puts a slight coating on the iron, and that is the way it protects it, and I run right around in a circle there that you have both attempted to get a patent for narrowing down to the subject we are dealing with, with the Grebe, if you put anything in hydrochloric acid for the purpose of storing it in a tank or transporting

it, which will put a coating on, namely, inhibit, the two seem to go together, one putting a coating on to inhibit, and then inhibiting by putting a coating on, they seem to cover the same thing, the patent says if anything is put in which inhibits, namely, it is described by putting a coating on, a hydrochloric acid solution with an ion, if used in a tank or transporting container made of iron, and Grebe describes the inhibitor, which means putting a little coating on, that if hydrochloric acid is used with the substance which will inhibit, namely, put a little coating on, in acidizing a well, it infringes. It seems as if they were both intended to be that broad.

Mr. Owen: I think you are right.

The Court: And they simply describe—one describes inhibition in the language of putting a coating on, and the other describes putting this little film on in the terms of inhibiting.

Mr. Owen: Well, Your Honor will—

The Court (interposing): I don't know, it seems as if it is a fair analysis of those two patents, and, so far as validity is concerned, as if these nice refinements, while they are interesting and probably necessary to an understanding of it, it seems as if whether I am thinking right now about the—well, both on validity and infringement, if that is what they intended to do, what they claim by it, they each claim that the other can't get away from their patent by anything new that I can think of discovered, when it comes to interpreting it on infringement, for the sake of getting away from infringement, it is a different bed, but, so far as the owner of the patent is concerned in claiming infringement, he claims that broad interpretation and he turns around and tries to narrow the scope of the patent in defending against infringement.

Isn't that about the—well, anyway, I just thought if anyone saw that that was a faulty thought there I will give you a chance to puncture it.

Mr. Owen: The only modification I would make of it or suggestion of a modification is that while both of the

patents do include broadly the use of an inhibitor, whether it be a metallic inhibitor or a non-metallic—

The Court (interposing): —or a combination—

Mr. Owen (continuing): —or a combination, that that is only one of three broad and undefined branches of the Gravell claims. In other words, they not only claim the use of any such inhibitor but they claim it with the use of any kind of an acid, and they claim at least ten different classes of metals in combination with hundreds and thousands of different non-metallic substances, whereas the only charge of undue breadth—if you might so call it—in the Grebe Sanford patent, is the one thing, and that is inhibitors. The acid is specified and in some of the claims the particular strength of the acid is specified. And we will show, Your Honor, that that has something to do with the importance of this invention and with the success of it. So that I hardly think the two patents should be placed in exactly the same status.

The Court: Well, I am thinking particularly about the difference of one describing it as a film placed on the iron to protect it and the other describing it as an inhibitor. That is another way of describing the same thing.

Mr. Lyon: Your Honor has suggested if we had anything to add or emphasize, I would like to emphasize in connection with Your Honor's statement, not in contradiction of it, but in connection with it, that insofar as the idea is concerned or establishing is concerned of the idea, that an inhibitor could be used with a corrosive acid and would protect a steel container so that acid could remain in it, in contact with it for periods of time without substantial injury to the container. That idea is in the Gravell patent, which is four years earlier than the Grebe-Sanford patent. So I think that as they both use that same idea of one to protect a transportation tank and containers, and the other to use that idea as applied to a pipe in which you are transporting acid, it seems to me Your Honor should bear in mind not that these Gravell and Grebe-Sanford patents are of the same date and therefore entitled to the same

consideration but you should always remember that Gravell is prior to Grebe-Sanford and that Grebe not only borrowed from the entire prior art but he had Gravell to borrow from.

Mr. Owen: Well, I have already pointed out that our contention is that the Gravell invention was not directed to any such use as the plaintiff makes of protection to the tanks and the well tubing; that the Gravell invention was directed to solving the problem of storing and shipping acids in unprotected steel for indefinite periods.

The Court: They needed a better inhibitor to do the job.

Mr. Owen: You go to this Fawcett article that was discussed this morning and there Fawcett was endeavoring to provide an inhibitor which would make less corrosive 66, or practically 66 degree Baume sulfuric acid, which under the Interstate Commerce rules may be shipped in steel. Fawcett recognized that even though it is shippable under the regulations that there is danger in doing it. Gravell was seeking to solve that same problem and Gravell, as a matter of fact, did not solve it any better than Fawcett solved it.

The Court: But he would really need a better inhibitor.

Mr. Owen: Very much.

The Court: You could get along in Grebe's with a poorer inhibitor than Gravell's.

Mr. Owen: Oh, yes.

The Court: Because they were planning to keep it for a long time, a much longer time.

Mr. Owen: Yes. Our contention is that Gravell did not solve the problem that he disclosed in his patent.

The Court: And he was dealing with, not only to danger, but danger to life, which you are not dealing with in Grebe.

Mr. Owen: That is true.

The Court: So he really, in order to solve his problem, he should have had a better one, but that does not help Grebe, that thought right there.

Mr. Owen: Well, I think that it does, but I do not want to argue that now. I think that you have got to consider a patent in connection with the use to which the invention is intended to be put.

The Court: I was just thinking about the difficulty of accomplishing the result, the result desired, and that is all I meant. I do not mean that it is more difficult to think of. I mean it is more difficult to get an inhibitor—it would take a better inhibitor to do well what Gravell had in mind doing, than it would to do what Grebe had in mind.

Mr. Owen: That is true.

The Court: I think that the reason I reached that conclusion is for two reasons, and one is that Gravell coupled not only the destruction of property and losses of that kind, but also the danger to life, which always is greater than the loss of property, the way my scales weigh things. I am only talking about the difficulty of getting an inhibitor that would do the trick, and I say that required a better one to protect life, and for long storages, than it would for an inhibitor that would protect the pipes of a well. That is entirely independent of the difficulty of thinking of it, and the ingenuity required to think of it.

(By Mr. Owen): Reference was made at a recent session to a statement contained in the file history of the Grebe and Sanford patent which counsel for the defendant urged as an estoppel against a construction of the Grebe-Sanford patent which would include the use of metallic inhibitors. Are you familiar with that file history, and if so, will you discuss that portion of it?

Mr. Lyon: If Your Honor please, I object to that. The file history is a document the court is called upon to construe, and its legal effect is a matter of law entirely. I do not believe any witness can change or modify or testify as to what the legal effect of the situation in a file history gives, and I certainly do not believe that we should take up the time of this witness discussing something which is purely a matter for the counsel to present to the court and for the court to rule on. He cannot change those facts, add

anything to them one way or the other by anything he says.

The Court: He might interpret some language there, if it was technical along his line, that wasn't technical along legal lines.

Mr. Owen: Well, this witness is a chemist, Your Honor, and I am not.

The Court: Well, I generally, most of it falls over into the class that Mr. Lyon has described, in the field of the lawyer, but there may be some of it over into the other field, in the way of interpreting the language and the meaning of it, so I will let it in. You may go ahead.

A. In the first place, when the Grebe and Sanford application was filed June 30, 1932, according to the record of the file in that application there were claims in the application reading as follows:

"In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well an aqueous hydrochloric acid solution to which has been added a relatively small amount of a corrosion inhibiting agent."

Of course there were other claims in addition to that one, but that is a typical broad claim insofar as the corrosion inhibiting agent is concerned.

Mr. Lyon: Now, if Your Honor please, the witness is not testifying to anything technical, he is not giving you any information as to the meaning of anything, he is just making an argument here, a legal argument.

The Court: I agree it is 95 per cent of the kind you describe, but we will go ahead with it.

A. That was the type, one type of claim that was in the application at the time it was filed, insofar as it concerned this corrosion inhibiting agent about which I have something to say on the technical side, and I point out that that was the language of the claim when the claim was filed, and it refers to certain types of chemical things.

Now, to go back to the time following that, when there was either an action by the Patent Office, or a response by

the applicant's attorney; at first, however, under date of July 30, 1932, there was an amendment prior to examination which affected the language of the claim I just quoted so that it was amended and as amended, it cancelled the term "a corrosion inhibiting agent," and substituted therefor "an agent capable of inhibiting the action of acid on metals." That is of course substantially the same chemical agency, but in somewhat different words. Some of the other claims were similarly amended, but apparently not at that time.

The Court: How did that change it? A. I do not see that that changes the scope of the claim in the least bit insofar as the choice—

The Court: If it did, I didn't get the meaning. A. It doesn't change the choice of chemicals to be used in the process at all. It was just another form of language for the same thing. At the same time as this amendment prior to the office action two other claims were presented, the specific feature of these being in connection with the process, the incorporation in the acid of an organic nitrogen base as one of the inhibiting agents, in an organic sulfur compound as another, in the two claims respectively that were thus added. And the remarks that accompanied that amendment were as follows:

"The foregoing amendment to the specification is for the purpose of correcting and clarifying the text in certain details. The new claims added are of similar scope to claim two that reads to two additional species. Claim 1 is to be regarded as a generic claim and claims 2, 10 and 11 read to the three selected species in accordance with rule 41."

And then an office action was mailed from the Patent Office on August 8, 1932, in which a number of references were made of record. Now, the Examiner made the rejection of Claim 1 and some of the others, on Ranney et al., 1,806,499, the Examiner stating, "—who carries out all steps of the process except that he makes no mention of using inhibitors."

The Court: Ranney, you said, did describe all the

uses except inhibitors? A. That is what the Examiner says. I don't think that Ranney went that far.

The Court: Ranney did not use it in a well, did he? A. Ranney did not use any inhibitor in the well, and he did not carry out the acidizing of the producing formation, as I recall that particular patent.

The Court: They haven't yet found that old 1896 one at all? A. Not yet, no.

Mr. Lyon: They never cited that at all in the Patent Office. It was mentioned in the specification, but the Examiner never referred to it. A. It was referred to by the patentee in his specification. So there was no point in the Examiner citing that. It was already of record. The Examiner goes on to state, (reading): "However, the use of chromates and mud fluids as inhibitors is suggested in the book on petroleum development and technology, and also in Bulletin 233 of the Bureau of Mines. The use of mud as an inhibitor is suggested by Lake, et al."

Then the Examiner goes on to state, (reading): "Furthermore, any dissolved chloride would operate as an inhibitor by suppressing the disassociation of the hydrochloric acid, and such chlorides would inevitably be present."

He continues (reading): "In view of the foregoing considerations, it is not thought possible to draw any allowable claim which is not limited to some specific kind of inhibitor, and in the absence of any allowable generic claim, an election will have to be made between the use of arsenic, nitrogen and sulphur compounds as inhibitors. Division is therefore required between claims 2, 3, 4, and 6, claim 10, and claim 11."

Now, after that action by the Examiner, there was a response by the applicant to the Examiner's statement—(reading): "Furthermore any dissolved chloride would operate as an inhibitor by suppressing the disassociation of the hydrochloric acid and such chlorides would inevitably be present."

This response considers in considerable detail all the

references, and I might also point out that the Frasch patent is mentioned in this response, the language being, "The utility of hydrochloric acid treatment in increasing the flow of an oil well was first pointed out by Frasch in United States Patent 556,669, in 1896, but this method has never found general application due to the danger of corroding metal apparatus within the well."

And the argument continues that "Present applicants have found, and are first to find that any of a wide variety of inhibiting agents may be added to hydrochloric acid to prevent its attack upon metal surfaces within a well, and that the so treated acid may be employed to increase the flow of a well without danger of corroding metal surfaces within the same."

Mr. Lyon: I do not think this witness is adding anything in the form of fact testimony.

The Court: He is not doing any harm.

A. (Continued): Well, perhaps I am exhausting your patience a little, but I have to get the background here so that the language that is used here will be understood with reference to the connection. It can't be taken apart and reveal some meaning not intended by the party using the language.

Mr. Lyon: I move to strike that out. That is a legal opinion, not a fact the witness is permitted to testify to.

The Court: Motion denied. Overruled.

(Witness continuing): Since hydrochloric acid which contains a corrosion inhibiting agent does not attack iron, the acid, as pointed out on page 4, lines 15 to 17 of the specification, "can be introduced into the well through the pump tube so that the latter need not be withdrawn prior to the treatment." (reading from page 2 of response of 8-12-32): "Applicant's method, which is now being used extensively in certain oil fields, is advantageous over that described by Ranney in that applicants treat a well with aqueous hydrochloric acid which contains an agent capable of inhibiting the action of the acid upon metals within the well. Claims 1, 5, 7, 8, and 9 which were rejected on

Ranney, distinguish from the latter in specifying that the hydrochloric acid with which a well is treated shall contain such inhibiting agent." The response continues—"In the last Office action it is stated: 'The use of chromates and mud fluids as inhibitors is suggested in the book on "Petroleum Development and Technology" and also in Bulletin No. 233 of the Bureau of Mines.' This statement is thought to be incorrect. In lines 9-13 of page 497 of "Petroleum Development and Technology" it is stated: 'In fact we find that both the depth of pitting and the total amount of corrosion may be limited by the use of sufficient chromate. If an insufficient amount is used to inhibit corrosion the result would probably be a slowing down of average rate of corrosion by an acceleration of local corrosion in the form of pitting.'" From the photostatic copy which is available of the above reference it is not clear what type of corrosion is referred to or to what purpose the corrosion inhibitor is to be applied.

However, the reference shows clearly that a chromate cannot be applied successfully to prevent corrosion within a well, as it is perfectly evident that during pumping of the well the amount of chromate present would be reduced, but that a small amount of chromate would undoubtedly remain within the well and such small amount of chromate would increase the pitting of iron by corrosive agents. The above reference does not refer to the use of mud as a corrosion inhibitor.

"Bulletin 233 of the United States Bureau of Mines gives a full discussion both of the use of chromates in preventing corrosion of iron apparatus within a well and of the use of mud for similar purpose. The chromate treatment is described on pages 84 and 85 of said reference and consists in immersing the iron or steel in solutions of inhibitive agents such as solutions of chromic acid and of certain chromate and bi-chromate salts. Obviously, such treatment of iron apparatus must be carried out before the apparatus is placed within a well, hence the inhibiting agent, a chromate, is not employed along with an acid which

is to be introduced into the well. Furthermore, the reference specifically points out that such chromate treatment, when applied to iron apparatus which is to be used within a well, is useless as such corrosion inhibitor does not afford protection against chlorides or sulphates which may be present within the well."

And now we come more particularly to the language of the Examiner, and this portion of the argument, apparently, is coming to that, as I have already read, this last sentence, the last part of which refers to the chloride being present within the well, rather than in the acid which is introduced into the well. And I quote now:

"'The protection afforded underground equipment by chromate solutions is of doubtful value not only because the passive surface of the metals becomes scratched and worn away but mainly because the passivity is temporary at best, and is destroyed by chlorides and sulphates if present even in very small proportions in underground waters. A few hundredths of one per cent of a chloride or a somewhat greater proportion of sulfate appears to destroy the passivity afforded by chromate solutions. Chromate solutions may have special uses as inhibitors of the corrosion of surface equipment in the oil and gas fields, but for underground use in wells these reagents are believed to be useless.' The above quotation shows clearly that a chromate will not prevent corrosion of iron or steel by a chloride and this fact is particularly true if hydrochloric acid, which is known to be highly corrosive to iron and steel, is the chloride referred to. A chromate, then, cannot be used in small proportion along with hydrochloric acid to prevent said acid from attacking iron equipment within a well, hence a chromate cannot be used as an inhibiting agent in the manner described in the present application. The reference does not describe treating a well with hydrochloric acid containing a corrosion inhibitor nor does it show there to be any advantage in treating a well with such mixture. The reference, then, does not anticipate the present invention."

Now, that response continues, refers to the Bureau of

Mines and also to the Lake et al. patent, and as to that I think I should read that portion of the argument that was intended to show that the Lake et al. reference had no bearing on this invention.

"Lake et al. describe removing colloidal muds, clays, etc., from the walls of a well hole or from apparatus within said hole by introducing into the well that amount of a strong mineral acid which is required to destroy the colloidal properties of the muds, clays, etc. On page 1, lines 100 to 109 of his patent, Lake states: 'It is found that the acid or acids used for these purposes will not appreciably attack the metallic structures in the well hole, such as tubing and casing, collars, and the like, where mud is present in the hole, unless used to excess, inasmuch as when an approximate balance between the amount of acid and colloidal mud is maintained, the acid action will be expanded upon the mud rather than in attacking the metal.' Lake does not disclose the use of mud as an agent capable of inhibiting the action of excess acid on iron equipment within a well. To the contrary, he specifically has pointed out in the above quotation that the protective action of the mud is due to it reacting with the acid more quickly than will iron or steel, and he also has particularly pointed out that the acid must be employed in amount which shall not exceed that with which the mud will react, i.e., there must be a balance between the mud and the acid. Present applicants have shown that a relatively small amount of any of a wide variety of inhibiting agents may be added to hydrochloric acid and that thereafter said acid may be introduced into a well to increase the flow thereof without injury to any metal apparatus which may be within the well. In employing an inhibiting agent for such purpose, the acid is in great excess over the quantity of inhibiting agent present. Insofar as is known, there is no chemical action between the corrosion inhibitor and the acid, and the acid is present in free form so that all of its activity may be expended upon the oil containing calcareous rock structure rather than upon iron apparatus present within the well.

Lake does not show that mud may be introduced into an excess of hydrochloric acid, and that the so-treated acid may be introduced into an oil well without injury to metal apparatus which may be within said well, and it is not thought that mud can be employed for such purpose. Lake does not disclose any inhibiting agent capable of preventing the action of excess hydrochloric acid upon the metal apparatus which may be present within a well treated with said acid, nor does he disclose adding any inhibiting agent to hydrochloric acid, and subsequently treating a well with the acid. Lake, then, discloses no essential feature of the present invention and does not anticipate the same."

Muehl is referred to and it is shown not to be in this invention, or even to disclose or suggest it.

Tilton is also referred to and shown not to disclose or suggest the invention.

The same applies to Coggeshall, DeGroote, two DeGroote patents, and then we come down to a specific portion of the last office action which is quoted here in my copy, it is on page ten. The quotation being:

"Furthermore, any dissolved chloride would operate as an inhibitor by suppressing the disassociation of the hydrochloric acid and such chlorides would inevitably be present."

Now, in view of the references cited, and the context, the question is whether or not the language "such chlorides" refers to anything but the chlorides that would be inevitably present in the well, and of course such chlorides which would be inevitably present in the well are those of the earth constituents or the constituents of the brines that are quite often found in wells, namely, the sodium, potassium, calcium and magnesium chlorides.

Now, after quoting this portion of the office action, the response goes on to state that there is an accompanying affidavit by one of the inventors. This affidavit shows that sodium chloride, which is a typical chloride of the kind which would inevitably be present in a well due to the fact that these things are present in the earth, and so forth, has

no inhibiting action, and the argument continued after setting up this affidavit and stating what it purports to show, namely, that even a saturated solution of sodium chloride in hydrochloric acid does not reduce its corrosiveness. The argument follows:

"Hydrochloric acid is one of the strongest of all known mineral acids and sodium chloride cannot be dissolved in aqueous hydrochloric acid in amount sufficient to suppress the ionization of the acid to such extent as to prevent it from reacting with iron or steel."

You will notice that they are discussing here the kinds of chlorides which might, if they do at all, reduce the corrosiveness of the acid by virtue of suppressing the ionization and not by virtue of putting a protective coating on the object that the acid is trying to corrode.

The argument goes on:

"The relatively small amount of brine, which may be present in an oil well, would have no appreciable action in suppressing the ionization of a hydrochloric acid solution. Neither sodium chloride nor other metal chloride may be employed successfully to inhibit the action of hydrochloric acid upon iron or steel and if they could be so employed they would, at the same time, inhibit the action of said acid upon the calcareous rock with which it is intended that it shall react."

In other words, the chlorides with which they are concerned in this discussion are merely those which might suppress the ionization, but they would not act as inhibitors in the sense in which the term "inhibitors" is used in the claims that I read first, and which were filed with the application at the time it was filed.

Mr. Lyon: Now, I want to move to strike that last sentence of the witness, that testimony, Your Honor, on the ground it is entirely improper, for the reasons I have stated in my objection, and entirely unfounded. This is a matter for the court to read this language, not for some witness to try to explain away language in the file wrapper. It is a question of law what effect this language has on this patent,

and the witness hasn't pointed to any ambiguity in the language, or attempted to aid the court by resolving any ambiguity, hasn't claimed there is any, hasn't pointed to any. The language says:

"Neither sodium chloride nor other metal chloride may be employed successfully to inhibit the action of hydrochloric acid."

The Court: I will overrule the objection.

A. Going back to that language which states that:

"Neither sodium chloride nor other metal chloride may be employed successfully to inhibit the action of hydrochloric acid upon iron or steel."

It is apparent from what I have previously read that the metal chlorides referred to are those which might, if used in sufficient amount, reduce the degree of disassociation of the acid, but they are not referring to metallic chlorides which are themselves inhibitors.

Now, I want to also point out—

The Court: This underlining, who did that, the Patent Office? A. No, that underlining was done in the response to the office action.

Mr. Lyon: That was the applicant who did the underlining, Your Honor. Are you going to read the next sentence in connection with the one you have just read? A. Yes. After the underlining, that is, as I have it in my copy, which ends with the words "shall react," a new sentence begins as follows: "Metallic chlorides, then, cannot be employed in place of the inhibitors disclosed in the application, hence the fact that such chlorides are sometimes present within a well does not invalidate patentability of any claim in the application."

Now, when we turn to the application, we see what metallic chlorides this is all about, we see immediately that arsenic is one of the metallic chlorides which is disclosed in the application, and now in the issued patent, which is an inhibitor as distinct from these chlorides talked about here, which are inevitably present in the well, and that might act to suppress disassociation of the acid, but do not act as metallic inhibitors.

The Court: Isn't there a little arsenic in the brine in the well? There is in the ocean. A. There may be a trace of a trace of a trace, but no inhibiting quantities are present. Arsenic is certainly not to be encountered in any significant amount in a well.

The Court: Do you say that it is obvious from the specification that Grebe and Sanford said to add arsenic chloride to the bath as an inhibitor? A. I used the words "arsenic chloride," yes, and that was because in this disclosure of Grebe and Sanford, which is the same as in the issued patent, he tells to use arsenic in hydrochloric acid, the arsenic being added as either the trioxide, or as an arsenate, and that there will be an arsenic chloride solution in the acid, and that is, of course, a metallic chloride, and obviously that—

Mr. Lyon (interrupting): The patent does not say that. The specification does not say that.

A. Anybody knows that when you put those things in hydrochloric acid, it becomes arsenic chloride.

Mr. Lyon: I don't know it, so don't include everybody.

A. The Beneker patent has that, and there were many others that showed that same thing.

Mr. Lyon: Instead of arguing with me, will you just answer my question. The specification does not state that the arsenic compound that is employed forms arsenic chloride, does it? A. I do not know that the words appear there.

Mr. Lyon: Is it your understanding that arsenic acid which is specified will form arsenic chloride in hydrochloric acid? A. Yes.

Mr. Lyon: Arsenic acid? A. Yes.

Mr. Lyon: Will it form pentachloride? A. Yes.

Mr. Lyon: Is there such a thing? A. In a hydrochloric solution, yes.

Mr. Lyon: Is there pentachloride? A. Yes.

Mr. Lyon: Are you sure about that? A. You can refer to the handbooks to see, I should say.

Mr. Lyon: Suppose you refer and see if there is such

a thing as arsenic pentachloride. A. It forms a chloride, it says, perhaps it is not penta—it is most likely an arsenic trioxide—

Mr. Lyon (interrupting): When you said a moment ago that all you had to do was to refer to the application and you would find a disclosure of the use of arsenic chloride, why, you meant that you would find that arsenic compounds were added, and that, you say, forms chlorides, but the patent specification does not say so. Is that what you mean to say now? A. The chemical books are that if you proceed, as taught here, you will form a metallic chloride solution, the chloride being arsenic.

Mr. Lyon: Did the Examiner know that? The application did not tell him? A. He undoubtedly would know that.

Mr. Lyon: How do you know that? A. Because everybody knows it.

Mr. Lyon: I didn't know it. A. You probably don't know the chemical books then.

Mr. Lyon: I don't know whether the court knows it or not, or whether he knew it before he went into this case. A. The Beneker patent disclosed that information.

Mr. Lyon: I want Your Honor to get the right conception of this, and that is, if this witness is going to read this file wrapper and make an argument, he ought to be accurate. He says that the application discloses adding an arsenic compound which he says will form chloride, but the application does not disclose that it will form chloride. A. That doesn't prevent them from forming. It is a fact of nature.

Mr. Lyon: Now, were you going to read this next sentence, or have you? A. I have read that two or three times now.

Mr. Owen: I would like to continue with my examination.

Mr. Lyon: All right.

Mr. Owen: I did not object to your questioning, because I thought the court would be interested in having the point cleared.

Mr. Owen: I will ask you if there is any difference in the manner in which arsenic acid placed in hydrochloric acid will act as an inhibitor against corrosion of iron than there would be if arsenic trioxide were placed in the hydrochloric acid? A. No. The first action would be the conversion of the arsenic by the acid into arsenic ion and chloride ion and the inhibiting action would then be identically that of the arsenic chloride.

Q. And the inhibiting action cannot take place until the arsenic ion and chloride ion are formed; is that right? A. That is right.

Q. And at the time that affidavit was filed were there claims existing in the application which specifically claimed the introduction of arsenic compound as the inhibiting agent? A. Yes.

Mr. Lyon: I would like to have my objection stand to all of th[illegible] testimony, without repeating it, Your Honor.

The Court: It does.

Mr. Owen: Will you point out one or more of those claims? A. Claim 2, as originally filed, read as follows:

"In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well an aqueous hydrochloric acid solution to which had been added a relatively small amount of an arsenic compound."

Q. Now, would arsenic acid be an arsenic compound? A. Yes, it would.

Q. And would arsenic trioxide be an arsenic compound? A. Yes, it would.

Mr. Owen: Does the Grebe and Sanford patent disclose more than one form of arsenic compound? A. Yes.

Q. What forms does it disclose? A. Page 1, column 2, in the last paragraph, beginning at about line 78, the statement is:

(Reading): "As the inhibiting agent we prefer to use an arsenic compound soluble in the acid solution, examples of which are arsenic acid, H_3AsO_4, arsenic trioxide, As_2O_3, or a soluble arsenate or arsenite, such as the corresponding alkali metal salts."

The Court: Corresponding to what? A. That means corresponding to arsenate and to arsenite. Arsenic forms two series of salts; the compounds which are trivalent correspond to arsenites, and the compounds in which arsenic is pentavalent correspond to arsenates.

Q. Will you write on the blackboard the equations which represent the reactions of these different arsenic compounds when placed in hydrochloric acid? A. I will take a typical example, which will be arsenic trioxide, as that is the common commercial compound of arsenic; As_2O_3 is the formula of arsenic trioxide. HCl is the formula for hydrochloric acid. When these two materials are brought together, the trioxide is converted into arsenic trichloride, and water is formed, H_2O.

The Court: I don't think you have enough parts on the left of the board there. You have got to put some figures in front of them. A. That is right. The next step here will be to balance up this equation so that the quantities on this side add up to the quantities on that side (indicating). There we have a little more water here.

The Court: Yes. A. Now, then, we have three oxygens here and three there. Six hydrogens there; six here. Six chlorines, and twice three is six chlorines. Two arsenic and two arsenic. So that it balances up. That is the same reaction that is given in the Beneker patent No. 914,916 issued March, 1909, to which reference has already been made in the previous part of the testimony.

CROSS EXAMINATION

By Mr. Lyon:

In your opinion, would it have been obvious to a man skilled in the art, from the knowledge of electroplating solutions, that corrosive acids such as hydrochloric acid and dilute sulphuric acid could be safely transported and stored in steel containers? A. I don't know whether it would have been obvious or not.

Q. Well, what is your opinion? A. It doesn't—from

what I have seen in the literature, it is apparent it would not have been safe.

Q. It would not have been safe to have shipped hydrochloric acid or dilute sulphuric acid in steel containers? A. That is correct.

Q. Would it have been apparent from this knowledge that you referred to, this prior knowledge in electro plating solutions, that hydrochloric acid could be transported from storage stations to oil wells in steel transportation tanks if you had added to such hydrochloric acid the same solutions? A. It is obvious there would be less corrosion.

Q. I am not asking you that. A. What are you asking me?

(Whereupon the question was read by the reporter.)

A. I don't know what you mean by the question.

Q. I will attempt to restate it. You have in mind this prior art prior to Gravell that you have referred to which disclosed different solutions or different formulas employed in electro plating operations, have you not? A. I have referred to some such, yes.

Q. And you have those in mind? A. I have some of them in mind.

Q. Those solutions or formulas which you have referred to are the ones I am going to inquire about in this testimony. Now, in your opinion, would it have been obvious to a skilled man from knowledge of those electro plating solutions that he could have transported hydrochloric acid from storage stations to oil wells in steel tanks or containers without serious injury to the containers if he had added such solutions to his acid? A. It would have been obvious that there would have been less corrosion if he had used those compositions.

Q. Well, would it have been obvious to him there would have been sufficiently less corrosion to enable him to transport the acid in that manner that I have described? A. No, I think not. It would be obvious that if you had attempted it, although the corrosion would have been reduced in some cases depending on what solutions were used there still would be a hazard, a great hazard.

Q. Then, as a matter of fact, no one prior to Gravell actually disclosed, in your opinion, enough information to necessarily teach one that corrosive acid could be transported or stored in steel containers without substantial injury to the container. A. The art that I have come across disclosed exactly as much as the Gravell patent.

Q. I didn't ask you that. A. That is what it sounds like to me.

Mr. Lyon: Will you read the question to the witness, please? A. The reference disclosed the same information that the Gravell patent disclosed, Gravell mis-stated what the result was.

Mr. Lyon: I move to strike out the answer.

The Court: What he is asking you doesn't involve the Gravell patent at all.

Mr. Lyon: Excepting fixing the time. A. Then I don't understand what he wants to know.

Mr. Lyon: Then read the question to the witness.

(The question was read.)

A. Disclosed the same information as Gravell disclosed.

The Court: Now, then, I will leave "Gravell" out and ask the question, you misunderstand it; did anyone, prior to July 31, 1928,—now put your question without involving Gravell at all.

(Mr. Lyon): —sufficiently disclose so that it could be known by one skilled in the art that a corrosive acid such as hydrochloric acid could be stored or shipped in a steel container if you added thereto any type of an inhibitor? A. That depends on what you mean by "storage" and what you are talking about; you haven't told me; I can't answer that any more than I have already answered.

Q. Well, let's ask you to answer that question with reference to transporting the acid from a storage station out to a well, in a steel transportation tank. A. You will have to be more definite; that is still indefinite.

Q. What is indefinite about it; don't you understand that? A. No, I don't. You will have to make it specific.

Q. Is it you don't want to answer these questions? A. Oh, no, I am willing to answer them, but I cannot answer this indefinite question.

Q. You are not trying to dodge these questions? A. Oh, no, I will answer as far as I know the answer.

Q. Let's take the distance from Mount Pleasant out to one of these wells, these four wells, let's take the Crawford well that your side has produced evidence, samples taken from that well; how far is that? A. I don't know.

Q. You don't know how far any of these wells were? A. No, I don't.

Q. Well, let's say they were 75 miles? A. Well, I don't see what distance has to do with the problem; maybe it has.

Q. All right. What is the thing you don't understand about the question, if it isn't the distance? A. The whole question, if you can pin it down to some specific material and conditions under which it is to be used, and so forth, it might be possible to give you an answer.

Q. Well, what fact of the question do you need to know; you tell me. A. Well, you will have to repeat the question now, I have forgotten the details of it.

(The question was read.)

A. Well, I would like you to specify the concentration of the acid, the conditions of temperature; the kind of container; the conditions under which the container is to be manipulated; and the time this is to go over, and so forth.

Q. You would have to know all of those things to be able to answer that question? A. I believe so.

Q. You cannot answer it without all of those details? A. Because time is a factor—

Q. I am not asking you to argue it. I am asking you to answer my question. Is it your statement that you cannot answer that question without all of those details? A. I cannot give you a definite answer yes or no, if that is what you mean.

Q. I didn't ask you for a definite answer yes or no. A. I thought you asked whether it could be done, in the

light of this knowledge that is in the prior art. Isn't that a yes or no question?

Q. Haven't you an opinion as to whether it would have been obvious to one skilled in the art to do that, or not? A. I think with some compositions it would have been, yes.

Q. What compositions? A. Those that appear in the—some of the compositions that appear in the Watts article, where the rate of corrosion of any of the acid solutions containing some metals is relatively low.

Q. Let us talk about hydrochloric acid. A. Well, as to that acid, I presume that it would be partly obvious and partly not obvious depending upon the time factor.

Q. Well, how long? A. If we had to do this in a relatively short time, one could get away with it with a relatively small reduction of corrosiveness of the acid, but if one had to allow the acid to remain in contact with the container for a relatively long time, then I don't think it would be obvious to do any of these things.

Q. Well, what I am getting at is this: I am talking about the use of a tank, steel tank for transporting 15 per cent hydrochloric acid from service stations out to oil wells. If I am going to use the tank, I am going to use it repeatedly and one day it will be—a truck will go to a well that is further out than another one, and you know, you are in this business, you know those conditions. And I want to know whether it would, from this prior art that you have presented here, showing these solutions that were employed in the electroplating, in your opinion it would have been obvious to anyone skilled in the art, that he could have transported his 15 per cent hydrochloric acid in the regular conduct of his business from his storage station out to his oil well safely, using those solutions or adding them to the acid? A. Oh, I don't believe I would know whether that was obvious or not.

Q. You wouldn't know whether it was or not. Have you any opinion? A. Well, I could express an opinion there, I think.

Q. What is your opinion? A. I think it would be obvious that those solutions would be less corrosive than the acids of which they were composed, in many cases, and if conditions were such as to permit it, it would be obvious that they could be carried around in iron or steel.

Q. It would be obvious, then, from that, that the metal in contact with the acid would not be injured by the acid, isn't that correct? A. Oh, no. The references do not disclose that. The references disclose that the corrosiveness of the acid within which these metallic inhibitors are used, is greatly reduced. In no case do we reach the stage of what one might call prohibition, that is, where no corrosion occurs at all. That object is never attained by any of these prior art references.

Q. Let's put it this way: Are you familiar with the extent to which the tank, steel tanks, employed by the Dow Company, corrode in actual use? A. No, I am not.

Q. In the presence of inhibitors? A. No, I am not familiar with that.

Q. You haven't any information? A. I have never seen the inside of a Dowell transportation tank.

Q. You haven't any knowledge of how much corrosion they do prevent? A. No, I haven't.

Q. Have you any opinion about how much they can prevent? A. Well, I could make a guess, but it wouldn't mean anything.

Q. Well, do you think that anyone would know from—any skilled man would know from this prior art that you have read here, described in the solutions used in electroplating operations, that by the use of such solutions he could transport 15 per cent hydrochloric acid in steel transportation tanks from storage tanks out to oil wells, and not get any more injury than the Dowell Company gets? A. Well, you are asking me for something as to which I don't know. You are asking me how much injury the Dowell Company trucks have, and you want me to use that as a standard of comparison, and I just said I don't know how much injury they suffer in this business.

Q. Do you think that these prior patents and publications describing these solutions or formulas used in electro-plating operations would necessarily disclose to a skilled man in the art that by using them he could transport or store 15 per cent hydrochloric acid in steel containers at all, without substantial injury to the containers? A. As I said before, it depends on the degree of this thing you are talking about, its composition.

Q. I said, "at all" first. I said "at all." A. None of them, as I have said, are so little corrosive that they do not do some corroding, as compared to, say, something like water. As I said before, those solutions that are in the electro-plating art there, show that they are relatively less corrosive than the acids themselves, and to that extent, of course, it suggests that they could be brought into contact with iron or steel without doing as much damage to it as the plain acids would; but the articles themselves, except for a few that I mentioned, do not suggest carrying such acids about in iron or steel.

Q. Is there any disclosure in the prior art that you have referred to in your opinion which would establish to any skilled man in the art, that the solutions or formulas mentioned in the prior art could be used with 15 per cent hydrochloric acid, to reduce the rate of corrosion to a point where you could probably store or ship such acid in steel containers, without serious injury to the containers? A. Well, that is a problematical question, of course.

Q. But I am asking you for your opinion? A. Yes.

Q. You studied this prior art? A. Yes, but as I said before, these compositions are a great deal less corrosive in some instances than the plain acid itself; and one reference which I do not think has been referred to on my direct testimony, discloses that in about a 19 per cent solution of hydrochloric acid, certain of these Gravell metals reduce its corrosiveness; but I don't think—I do not have a reference which answers your question, which is directed to the 15 per cent hydrochloric acid. I cannot give you that because I do not have a reference which discloses that specific proportion.

Q. Have you a reference on the same question for any corrosive acid of the— A. Yes—sulphuric acid, for example?

Q. Which reference? A. The Watts article, an article by Watts in the American Electro-Chemical Society, 1909,—that discloses many Gravell metals, some of which when put into acid greatly reduce corrosiveness, and others of the Gravell metals which accelerate this corrosiveness.

Q. Now, does the article teach in regard to arsenic, Watts' article? A. That article shows that the addition of arsenic greatly reduces the corrosiveness of that acid.

Q. Wouldn't it be obvious from that article that you could safely transport or ship corrosive sulphuric acid in steel containers without serious damage to the containers, if you added arsenic? A. It would be obvious as to about what extent damage would occur if the acids were so transported or shipped.

Q. What do you mean by that last answer? A. That the rate at which acid attacks steel or iron is given in research work of Watts, and from that an estimate of damage to a steel container could be made.

Q. Do you agree that all that any inhibitor that anybody knows of, or has suggested, can do, so far as the corrosive rate of a corrosive acid is concerned, on steel, is reduce it more or less, but cannot completely eliminate it? A. I haven't found a reference showing an inhibitor which goes so far as to prohibit corrosion by the acid on your steel.

Q. When you say "a reference," you haven't found any such inhibitor anywhere that you know of? A. That is right.

Q. Now, you mentioned what this article by Watts— A. That is, in printed matter; I am not saying I don't know of some to exist, but—

Q. Well, you know what arsenic will not do? A. In printed publications and things that are available to the public.

Q. Well, arsenic will only somewhat reduce the rate

of corrosion, it will not completely stop it? A. Arsenic will not completely stop it, but it comes right close to it with certain concentrations of sulphuric acid, but it does not actually stop it, of course, because in order to work arsenic has to plate out and in order to plate out iron has to dissolve, and if iron dissolves, it is dissolving, it is not remaining inert or unattacked.

Q. Is your last testimony equally applicable to the effect of arsenic in 15 per cent hydrochloric acid? A. I don't know what you mean by my last testimony.

Q. I mean your explanation of what arsenic will do in corrosive sulphuric acid; is that also true of arsenic in 15 per cent hydrochloric acid? A. Not in the same—not to the same extent. I believe from what I have found in these references the effectiveness of arsenic in reducing the corrosiveness of hydrochloric acid is quite a lot different than its effectiveness for reducing the corrosiveness of sulphuric acid, giving due regard to the concentrations.

Q. Tell us about it. A. The effect of arsenic varies with the concentration of the acid in which it is placed.

Q. Well, I have given you 15%. A. Yes. Well, as I stated, with that specific concentration I do not have a reference that gives us very much help. The nearest we can come to it is the Watts article that has about a 19% solution, as I recall it. I am not absolutely positive in that solution he placed arsenic.

Q. You don't know anything about these various matters I have been asking you about except what you can read in the prior art brought in, these patents you referred to. You don't have any independent knowledge of your own? A. Oh, yes, I have knowledge.

Q. Why do you limit your answers to the references you can find? Why don't you tell me what you know? A. I will be glad to if I understand the question.

Q. Now, you have referred to this article by Watts. Will you turn to page 338. This is the transcription American Electro Chemical Society, Volume 21, for the year 1912. A. Yes, I have that now. What page is it?

Q. Page 338. I am reading from a paragraph commencing in the middle of page 338. "It appears, then, that arsenic is unique among the metals which precipitate themselves upon iron from solution, for arsenic protects iron almost completely from powerful corrosive agents, while the other metals are generally considered to aggravate corrosion and rusting." Now, wouldn't anybody skilled in the art know from that that if you are interested in protecting an iron pipe or an iron tank in which you had a corrosive acid in contact with the metal that you could use acid, arsenic, and that arsenic would protect the iron "almost completely"? A. Well, you have to consider the findings on which that is based. Of course that is a general statement and doesn't apply to all acids, although the way it is stated here it seems to. If one looks at Watts' data on which that is based, you certainly couldn't reach any such general conclusion with respect to arsenic, I don't believe. However, it is different from the other metals in that respect; it does more than the other metals do.

Q. It is much more powerful as an inhibitor or corrosion reducer? A. Oh, yes, it seems to be in quite a different class than any of the other Gravell metals, with the exception of copper.

Q. Well, now, will you turn over to page 341, which is Mr. Watt's table, where he gives the results of his tests, and comparing the amount of corrosion in 24 hours with arsenic with the blank and comparing the amount in 48½ hours with arsenic in the blank, in per cent, how much corrosion was there with the arsenic as compared with the blank. A. It should be pointed out, of course, that this data is based upon experiments done with sulfuric acid and not with hydrochloric and that the concentration of—

Q. (Mr. Lyon interrupting): I didn't ask you anything about that. I asked you to compare. A. I can't give you the corrosion figure without reference to what it is about.

Q. Why not? A. It wouldn't have any meaning.

Q. I am not asking you to give the meaning. I am

asking you to give the calculation. A. What kind of a calculation do you want me to give?

Q. The blank in 24 hours shows 6.64 grams of corrosion, while with the arsenic it showed 0.07, did it not in that length of time? A. Yes, it did.

Q. And in 48½ hours the blank showed 10.32 grams, and with the arsenic it showed 0.10 grams, isn't that correct? A. That is correct.

Q. That is less than 1%, isn't it? A. The difference in weight losses is in the order of 1%, less than 1% slightly. In other words, in terms of our inhibition calculation that would be a sulfuric acid solution which was about 99% inhibited.

Q. You do not want to tell us whether in your opinion this prior art that you have referred to, take it altogether, would reveal to one skilled in the art, the fact that by the use of the solutions or the inhibitors there disclosed, he could transport or store a corrosive acid, such as 15 per cent hydrochloric acid, in a steel container? A. On the contrary, this Fawsett article does disclose and teach that very idea. He gives some quantitative figures as to the rate at which the container might be attacked.

Q. Well, then, from that article you would not need anything more to know that if you were going to transport 15 per cent hydrochloric acid in a steel tank, or through a steel pipe, but what you could protect that pipe or that tank from the corrosive action of the acid by using the inhibitors referred to. Do you agree with that? A. As I said before, the reduction in corrosiveness that can be had is indicated in some of these articles, for example, the concentrations, that I do not happen to find the 15 per cent hydrochloric acid. This Watts article on page 344 gives it for a 19 per cent, if you add arsenic to it, and we get about the same reduction in corrosiveness in 19 per cent hydrochloric as we get with sulfuric acid with arsenic, using about the same amount, I believe.

Q. Well, then, you would know from that that you could— A. So you can put those two together, at least.

Q. You would know from that, if you were a skilled man in the art, that you could use arsenic and protect a steel transportation tank or pipe from corrosion of 19 per cent hydrochloric acid? A. To this extent.

Q. Does that article indicate that the extent is enough to reduce the rate of corrosion to a rather small figure? A. Yes, but it does not state whether that is the same figure.

Q. Well, then, it is a question of somebody finding out whether you can safely use a tank or a steel container or a pipe for acid if the rate of corrosion is reduced to one per cent by arsenic. Is that the thing that was left for somebody to find out? A. I do not know if that was the thing that was left for somebody to find out, but that would certainly be something one ought to find out before trying this thing.

Q. All right. Let us put it in this way, it is now your opinion, is it not, that any skilled man from this prior art which you have produced, would know that if he was using a 19 per cent hydrochloric acid, he could protect a steel container or a pipe, from corrosion by that acid up to one per cent of the amount of corrosion which it would have if he did not use any arsenic? A. I think that would be correct.

Q. Now, you don't have any reference for whether or not 1 per cent is more corrosion than you can safely allow if you are shipping or storing in steel containers or pipes. Is that all you lack? A. Well, that is difficult to answer offhand. I presume it would be possible to compute from Watts' data and get the figure for comparing with the Fawsett data, and from that you could show that even though you had put in arsenic and thereby greatly reduced the corrosiveness of the acid solution, that same solution in a steel drum would, of course, eventually explode it, due to the fact it would generate hydrogen and burst the drum. Now, how fast it would be, would be a matter of time.

Q. How soon would that take, how long would that take? A. I can't make the calculation offhand. It would

take some time. All these things take some time. They don't occur instantaneously. The prime factor is indicated in part by this corrosion rate figure, although it is not an absolute measure of this thing.

Q. Can you give us some idea, if you cut it down, cut the corrosion rate down where it is—the remaining amount of corrosion is only 1 per cent, how long would it take to explode an air-tight container? A. Well, 1 per cent of what?

Q. Well, take dilute sulfuric acid and give us the figure for that, if you can? A. Oh, I should imagine a few hours.

Q. How about 15 per cent hydrochloric acid? A. Oh, it would be a few hours. It would not take very long before the drum would explode.

Q. Even with arsenic? A. That is right.

Q. And when you ship these—do you know whether or not these transportation tanks are air tight or not? A. I don't know. I don't think they are.

Q. Well, is it necessary that if you are going to store or ship hydrochloric acid or corrosive sulfuric acid, that the container be air-tight? A. It is in some instances, I believe. Not in all.

Q. Well, in what instances is it necessary? A. I don't know.

Q. Well, this prior—this danger of explosion would be avoided if you had a tank vented, would it not? A. Well, only partly, because the contents of acid could come out, too, and it would not be very satisfactory.

Q. If you are going along in an automobile truck you could have a vented tank with no real danger or no actual danger of anything spilling out of it? A. I think so.

Q. Why, certainly. You haven't told me so that I am sure that I have an unequivocal answer from you, whether or not you think, in your opinion, this prior art actually discloses the use of inhibitors to such an extent that it would be apparent to a skilled man in the art, who wanted to know whether—wanted to know how to protect steel from

hydrochloric acid, that he could do it by using the solutions and materials disclosed in these prior references? Can't you give us an unequivocal, clear-cut answer? A. Yes. The answer to that is that it is so with certain things, not with all things either, but with certain of the things.

Q. Let's talk about hydrochloric acid. Would he know that if he wanted to protect steel from hydrochloric acid, that the thing to do would be to get such inhibitors as you have pointed out or disclosed in this prior art? A. For certain purposes. You have got to limit the thing.

Q. I am talking about the purpose of protecting the steel? A. Yes, but what do you mean by protecting?

Q. That is in contact with the acid. A. I don't know what you mean by protecting the steel.

Q. I mean protecting it against severe corrosion. A. Well, what do you mean by that?

Q. From the acid. A. I don't know what you mean by that. That is just relative language. It has no significance.

Q. It doesn't have? This word "inhibitor" doesn't have any significance? A. I didn't say that; all of these things which are classed as inhibitors reduce the corrosiveness of the acid on iron or steel.

Q. But that has no significance unless you know how much? A. Well, it depends on whether you are interested in the quantitative result or not; you are asking me for a quantitative result.

Q. Is the Grebe and Sanford patent interested in a quantitative result? A. No, you are interested—

Q. I am asking, is it interested in a quantitative result in any way? A. In this case it is interested in reducing the corrosiveness of the acid so that it will not damage the equipment as much as if it were not inhibited.

Q. Supposing the skilled man I am talking about was interested in reducing the corrosion that would be caused by hydrochloric acid in contact with steel, would he have known, would it have been apparent from this prior art that you have produced here today that he could have ac-

complished that by using the inhibiting materials and the solutions that are disclosed in that prior art? A. Absolutely. The art is full of inhibitors, not just this that I have gone through, but there is much more; I have just touched on a fraction of it.

Q. And he would know that was true so far as reducing the corrosion on steel contacted by the acid, no matter what that form of that steel was, I mean whether it was an article or a container, the only significant thing would be that there would be a steel surface in contact with the acid? A. No, I don't think you would go that far, although qualitatively that would be all right, but we do have some troubles that are due to the container surface itself, where there might be some inhomogeneity in the structure of the container.

Q. Well, a man would know that inhibitors that would reduce the corrosiveness of hydrochloric acid to steel would operate whether the steel that the acid contacted was in the form of a tank or in the form of a pipe, wouldn't he? A. Oh, yes, yes, bearing in mind, however, that there are some differences due to structure, but qualitatively they would be about the same as I have said, a pipe and a tank would be put in the same class, except for the possibility of the tank, a structure having different metallic compositions. A pipe is liable to be more uniform.

Q. Now, do you think there is anything wrong with Mr. Gravell's listing these different things as acid regulators or pickle control substances from the prior art? I mean did he get anything in here that the prior art didn't justify him in stating were known in the prior art as pickle control substances or regulators? A. I don't think there would be anything not to justify them other than the indefiniteness with which they are set forth.

Q. Let's compare the Grebe and Sanford patent in that respect. Turn over, please, to the Grebe-Sanford patent, bottom of the first page, second column—"Other inhibitors which may be used are cyanides, organic nitrogen bases such as aniline, phenyl-hydrazine, pyridine, quin-

oline, acridine and derivatives thereof, organic sulphur compounds, such as mercaptans, as well as various by-products of industrial processes, such as sludge acid from oil refining and residues from acid sulphite paper manufacture, etc." Now, let's compare this list, this third column that you have in your exhibit, made under the Gravell patent, and tell us how many different corresponding classifications are in this Grebe-Sanford patent at this point. A. These fit very well with that. Starting with the cyanides in Grebe and Sanford, that corresponds to 12 on the chart.

Q. Well, now, there is just as many cyanides included under that class in the Grebe and Sanford patent as there is under the Gravell patent, isn't there? A. I think it would be so. However, one must recall the fact here that what Grebe states is that you would choose inhibitors. I don't know whether all cyanides are inhibitors, but you are to choose them from such class as you wish.

Q. Of course, Gravell chooses from—he chooses from such of those materials as are known to be acid regulators or pickle control substances, doesn't he? A. I think that is correct, yes.

Q. Surely. Well, then, he is asking you to choose the same thing Grebe and Sanford is asking you to choose, isn't he? A. Well, that is the point of which I am not certain, because Gravell nowhere states what he means by an acid regulator.

Q. But the prior art taught that they were inhibitors, didn't it? A. The word "acid regulator" does not appear in the prior art, to my knowledge.

Q. "Pickle control substances" does? A. That does not, either.

Q. The word "pickle control" doesn't appear? A. I couldn't find it.

Q. I thought you read from things— A. We read "controlling."

Q. "Pickling solution." A. "Pickling solution" occurs, but we did not find those terms. You can read into them this matter, if you wish.

The Court: Aren't they necessarily inhibitors? A. No.

The Court: What? A. No.

The Court: Picklers. A. We can tell by looking at these they weren't. For instance, sodium bisulfate is not an inhibitor. It is a corrosive substance, very corrosive.

(Mr. Lyon): Well, let's take along here now. (Indicating on chart.) First thing are the cyanides. Just plain cyanides. You say there is 91 inorganic and 87 organic cyanides, on the chart for the Gravell patent? A. Yes.

Q. Is there anything there you omit, anything to select from those indicated in this Grebe and Sanford patent? A. The Grebe and Sanford patent indicates that they are to be inhibitors. But this doesn't.

Q. How do you know? Are all these 91 inorganic and all these 87 organic cyanides inhibitors? A. I don't know.

Q. Do you know whether there are any of them that aren't? A. I couldn't say that, either.

Q. Well, if there are some that are and some that aren't, the Grebe-Sanford patent don't tell you how to find one from the other, does it? A. No, it doesn't.

Q. Any more than Gravell tells you how to find which ones are acid regulators? A. That is right.

Q. Now, let's skip over to the next class, organic sulfur compounds. A. I misspoke myself, please. I don't want to say that this Gravell indicates that you should choose such of these cyanides as are inhibitors. There is no speaking of an "inhibitor" anywhere in the Gravell patent. That word is never used, and it don't appear in any part of the specification.

Q. But you do think he started to pick out those that have been used in pickle control as pickling compounds? A. I would think that was the import of that paragraph.

Q. And many of those, from your references this morning, actually act as inhibitors? A. Some of them do, but many of them don't. You have both kinds of things there. That is the reason there is a difference.

Q. Well, now, let's take this next class on page 2 of

the Grebe-Sanford patent, it says organic sulfur compounds. Where would they go on here? A. There aren't any on that Gravell chart, to my knowledge.

Q. How many organic sulfur compounds exist, theoretically, or possibly? A. Well, I don't know that. But, as a guess, there would be a great many.

Q. It would be up in the hundreds of thousands? A. Oh, I don't think so.

Q. How many? A. I don't know.

Q. Do you know whether they are all inhibitors or not? A. Undoubtedly not.

Q. Do you know which ones are inhibitors? A. The common ones that are known to be inhibitors are ethyl mercaptan, and the lower mercaptans. Many of the mercaptans are common ones.

Q. Any others? A. I think the thio-urea would be another one.

Q. When Grebe and Sanford here use the phrase "organic sulfur compounds such as mercaptans," do you think that that should fairly be construed as a statement that they were including all organic sulfur compounds? A. No, I wouldn't say that. What it conveys to me is that you can find in those classes such things as may be used as inhibitors and which were known in the art as of that time as inhibiting agents, and there are quite a few disclosed.

Q. You should read the Gravell patent in the same sense. A. I am, but with this distinction, that Gravell doesn't state that these things that are called acid regulators should have inhibiting action.

Q. He doesn't use the word "inhibiting"? A. Well, even more than that, he has listed in his group things that are not inhibitors, therefore I take it that he didn't intend to limit himself either in his disclosure to such things as would have an inhibiting action.

Q. Now, you condemn the Gravell patent for referring to sludge acid from oil refining, or what corresponds to that, in this column three of the Gravell patent. A. I don't think I condemned it.

Q. That is number 29, isn't it? A. This talks about the waste acids from refining hydrocarbons, that is not the same thing. Sludge acid is a very particular type of product.

Q. Is it or isn't it? A. It is my understanding it is.

Q. Where do you get it? A. I couldn't go into that.

Q. Your understanding is not very definite about what it is? A. That is true, aside—

Q. Do you know whether the acid sludge from refining a mineral oil differs from that from refining a gasoline? A. I don't know.

Q. Do you know whether it differs from the one you get from refining a lubricating oil? A. I don't know.

Q. Do you know whether all of them together differ from the same parallel sludges, if they are made with a different chemical? A. I don't know, but, as I say, I was under the impression that this sludge acid, was a relatively different thing, that you go to the refinery and you get that stuff.

Q. What do you think you would get if you went to an oil refinery and said, "I want some sludge acid." A. I don't know what you would get.

Q. Then as far as you are concerned, and your testimony is concerned, you would have to say the words "meaning indefinite," under item 29, on your third column, would apply— A. No, it is not the same language; item 29 says, "Waste acids from refining hydrocarbons."

Q. The meaning of sludge acid in the Grebe-Sanford patent is indefinite to you, isn't it? A. No, it is not indefinite to me, because I don't know what it is.

Q. How about "residues from acid sulfite paper manufacture"; do you find anything that corresponds to that on this? A. Yes.

Q. What is it? A. Number 10 may be, "cellulose pulp waste," it happens to be one place I suppose you might go to for that; I don't know what it is; and then there is something else further down, "sulfite lye," I think that is another term for the same sort of thing. How they distinguish from each other, I don't know.

Q. Do you know what this one is, what this material is and how definite a material it is that is referred to by Grebe and Sanford? A. No, I don't.

Q. Under the words "residues from acid sulfite paper manufacture"? A. I don't know, no.

Q. But you have testified now that a fair rating of a phrase like the phrase, "organic sulfur compounds, such as mercaptans" in the Grebe and Sanford patent, shouldn't be taken as implying that all organic compounds are included? A. That is right.

Q. Now, I want you to turn over to the Gravell patent and look at the last paragraph in the first column of the first page, line 41. "The metals which have that property are below iron and above mercury in the electro-motive scale. Under certain conditions tin produces good commercial results. However, arsenic in most cases is more satisfactory." It is true, isn't it, that tin is below iron and above mercury in the electro-motive scale? A. Yes.

Q. Copper chloride, lead chloride and iron chloride are all metallic chlorides, are they not? A. Yes.

REDIRECT EXAMINATION

By Mr. Owen:

Q. On page 338 of the Watts article, to which you have referred, I believe there is a statement to the effect that arsenic protects iron almost completely. I wish you would quote that correctly. A. On page 338 of Watts, in Volume 21 of the American Electro-Chemical Society transactions, I read as follows:

(Reading): "It appears then, that arsenic is unique among the metals which precipitate themselves upon iron from solution, for arsenic protects iron almost completely from powerful corrosive agents, while the other metals are generally considered to aggravate corrosion and rusting."

Q. Now, assuming that that statement by Watts is true, regarding the protective properties of arsenic, what would you say as to its being obvious to one who read that

statement that if one of these highly corrosive acids which he speaks of were placed in a steel drum, the presence of arsenic would have the effect of protecting the drum from corrosion? A. Well, if this statement were true, one could assume from this that arsenic would protect the drum from a corrosive attack by an acid.

Q. Supposing one desired to store one of those acids in a steel drum, and to protect the drum by the presence of arsenic, how would he proceed, or how could be proceed to ascertain how long that protection would last? In other words, how long the container would hold the acid from being eaten through, or being blown up, if the container were closed? A. He would prepare a solution of the acid, and add to it arsenic in a manner, of course, to get the arsenic dissolved in the acid, and put that solution in the tank, or, the container, and set the container aside, and watch what happened as time went on. If he would desire to test it either open or closed, he would naturally proceed to set some drums aside with the solution in that were sealed, and others that were not.

Q. If in that way he learned of the length of time which he could safely rely upon for the continuance of the protection obtained by the presence of the arsenic, what would he then have to consider in order to determine whether or not a drum so protected could be used commercially for a certain purpose? A. One would have to consider the interstate regulations, as to whether or not one could proceed with this thing without violating the Interstate Commerce regulations as to the shipment of such acid.

Mr. Lyon: If the court please, there are still some things that can be done in this country without crossing the state line. You still can do some business in this country without doing it in interstate commerce.

Q. (Mr. Owen): What else would this party have to consider in determining whether or not he could use this form of protection for the proposed purpose? A. A vitally important feature would be to determine whether or not the presence of this constituent would interfere with

the subsequent use of the solution after the storage and transportation of it was done.

Q. And if he found that the presence of the arsenic would give him sufficient protection to get by the interstate commerce regulations, and that it would not contaminate the hydrochloric acid so as to make it improper for its intended purpose, then I assume all he would have to do in deciding whether or not he would store or ship his acid so treated, would be to determine the length of the storage period or the distance and time consumed in transportation? A. That is right.

FRANCIS NELSON ALQUIST,

a witness called in rebuttal by plaintiff, testified as follows:

I have been employed by The Dow Chemical Company as a research chemist since about August, 1930.

I received my graduate degree from Clark University of Worcester, Massachusetts, then I was an instructor in chemistry at Rensselaer Polytechnic Institute, Troy, New York, Department of Chemical Engineering, Department of Chemistry at St. Lawrence University; took graduate work at the University of Chicago, and five years instructor doing graduate work at Purdue University at Lafayette, Indiana. I received my master's degree and doctor's degree from Purdue University, where I specialized in organic chemistry, minor, and inorganic chemistry, and

majored in organic and minored in chemical engineering dealing with metals.

The first few years I was with Dow I was engaged in organic research development of new compounds, new processes for the plant use, and then when Dow became interested in oil well work, I became interested in work along that line. Since that time about half my work has been spent on the chemicals in relation to oil well work, and about half in organic research.

I have been familiar with the Gravell patent No. 1,678,775 since probably November, 1939. The patent states, beginning at line 32:

"The invention is based on a discovery that acid solutions containing metals with or without so-called pickle control substances"—I would emphasize "with or without" —"when brought into contact with iron and steel automatically form a deposit or protective coating on the inner surface of the container which acts to prevent the acid solution from attacking the container."

Now, knowing from my early chemistry that metals like, for instance, copper in solution as copper sulfate, deposit on iron, I would wonder whether that was a discovery of Gravell's.

The patent then states that metals which have that property are below iron and above mercury in the electromotive scale. Now, the common metals below iron and above mercury are antimony, arsenic, bismuth, cadmium, cobalt, copper, lead, nickel, thallium and tin.

Mr. Owen: Now, was it your understanding when you first read this patent that the patentee intended to make any distinction or differentiation between the protective action to be afforded by these different metals? A. Well, up to this point, as I have read the patent, I see no distinction, but a little later on he expresses a preference for arsenic and tin. That is, he seems to use arsenic in his illustrations and he also seems to use tin and gelatin, about line 101 or 2. But that, as far as I get the meaning of the patent, wouldn't exclude any of these other metals if they

lay between iron and mercury. It says that under certain conditions tin produces good commercial results, however arsenic in most cases is more satisfactory.

The next thing that puzzled me a great deal about this is the idea of pickle control substances or acid regulators. The list of acid regulators is long and there are a great many things involved. For example, nitrogen ring compounds. That terminology includes a very large number of compounds. We checked up on that in various monographs dealing with ring compounds. For example, I found thousands of them listed in these books. And then, also, I found a large number of pyrols and pyridine bases. I had wondered if all those had been used. I didn't know whether Mr. Gravell had tested those or not, but I thought probably he had not.

The next item that interested me was this example down here on line 83, organic bases a quarter of a gallon, hydrochloric acid .75 of a gallon. Now, organic bases are listed above from lines 46 and 47 on.

The Court: Are those all organic bases? A. No, they are not all organic bases, for instance sodium bisulphate is not an organic base, it is an inorganic compound, cyanides may be inorganic or organic cyanides; there is no distinction in the terminology used. The starchy materials in water wouldn't be organic bases. To an organic chemist, an organic base usually contains nitrogen. For example, methylamine is an organic, having a methyl group, the nitrogen and two hydrogens, and there are a large number of those compounds in the aliphatic, as well as the so-called aromatic nitrogen compounds.

Now, going back to this example, I would like, for convenience in referring to it, to label these different examples in here with letters, for instance, the first one "A," the second one "B," and so forth, up to the letter "G."

In the example at line 24, where it says organic bases, why, there is no definite organic base mentioned there, so that means that I may use methylamine, I may use aniline, pyridine, or I may use mixtures of those, or mixtures of

different organic bases. But to me that example is somewhat indefinite. However, it is not indefinite to the extent that it means a starchy material, or anything like that, that is an organic base that is definite to the extent that it should be a nitrogen compound. A great many of these bases have an alkaline reaction in water solution, that is, if you add some of this methylamine to water, and test that solution with litmus paper, it will give an alkaline reaction.

Now, another thing about that example is that it says "hydrochloric acid," and that would mean to me any concentration of hydrochloric acid from 1 per cent up to, say, 35. And it says that that mixture must be shipped in glass, and it is to avoid shipping that material in glass that Mr. Gravell indicates in the next example, Example B, that he adds arsenic trioxide, .125 barrels. That "barrels" is obviously a misprint, and I think should be "pounds," because I don't think he intended to put barrels of arsenic in. "—the material may be shipped and stored in steel drums due to the protective coating formed, precipitated or deposited on the inner surface of the drum. Although arsenic plates out, the organic bases are not affected sufficiently to make any difference in the commercial use of the material."

I would take that to mean if he had the organic bases and the acid, that the arsenic would plate out of that particular mixture, and that that did not interfere with the use of the material later. That is what I take it it means.

Now, the next example, dilute phosphoric acid must be shipped in glass or rubber lined containers. But if you add to it an organic base and arsenic, to that material, it may be shipped in drums. Now, there is one great difference between Example D, starting line 24, and Example B up on the top of page 2. You notice that your ratio of organic bases is very high in Example B and very low in Example D, so that means that in this particular case there is a range of concentration, and he says that that doesn't interfere with the use of the material in its intended use.

Now, starting line 34, it says: "The proportion of

arsenic and organic bases may be widely varied in the admixture." Well, you have got in those two examples, B and D, you have got a wide variation, and it says: "—and the amount of the admixture added to the solution may be extensively varied, depending upon individual taste and commercial requirements." I would take it from that that the concentrations of material which Gravell intended to use could cover a wide range of concentration, within the limits that he has set up here in these two examples. Then I could go on with that same story about the other examples, but I think I have made the point clear.

Then, in line 76: "The admixture itself may be shipped safely in steel drums and it constitutes a satisfactory acid regulator or pickle control, because much of the arsenic is precipitated on the inner surface of the steel drum, leaving too small an amount behind to interfere with the commercial use of the acid regulator or pickle control."

That raises in a chemist's mind the question of, well, what amount of arsenic from these different examples is in the solution, and what amount is left in the solution which would be used commercially. It says:

"Or the admixture may be added to solutions of sulfuric or hydrochloric acid in sufficient amounts to prevent the solutions from attacking steel drums."

Then, in line 93 it states that: "Various modifications of the invention may be practiced without departing from the spirit of the invention, for instance, a steel drum may first be coated internally with arsenic and then filled with an acid regulator or pickle control solution, or acid solutions, containing an acid regulator or pickle control need only the addition of the proper metal, for example, an acid solution containing gelatine needs only the addition of tin."

Now, there is only two ideas in this paragraph here, but the first one is that you can coat the drum internally with arsenic. Now, he doesn't tell you how to do that, in so many words, but from what precedes you might assume that one is by putting the arsenic in the acid and putting that in the drum, and that would coat.

Then the next statement, if you have an acid solution which contains gelatine, you can add tin to it, and in that way get an admixture that is similar to those in the examples above.

Mr. Owen: How widely do the proportions of arsenic vary in examples B, D, E, F and G, as you have identified them? A. Well, they vary between about .0044 per cent up to about 1.72 per cent.

Q. Now, does the patent disclose to you anything that might be adopted as a standard for determining whether or not a solution must be shipped in glass? A. Well, the first example that I call A in column 2, about line 83, which consists of organic bases a quarter of a gallon and hydrochloric acid three-quarters of a gallon, it is stated that it is a mixture that must be shipped in glass, and the statement is clear.

The Court: By "C" I understand there a quarter of a gallon of 85 per cent phosphoric acid. A. That is correct, it is 85 per cent phosphoric acid and 15 per cent water, as I understand it in that table. You add to three-quarters of a gallon of water more, making a solution of phosphoric acid of approximately 30 per cent concentration, which he states is so corrosive that it must be shipped either in glass or in rubber, or rubber-lined containers.

Mr. Owen: Well, now, from these two formulas, "A" and "C," which the patentee states must be shipped in glass, can you find any standard of comparison whereby to ascertain whether or not a given solution would come within the terms of the patent if it contains organic bases and arsenic or some other metal than arsenic? A. Yes, I think that either the 30 per cent phosphoric acid or this organic bases mixture would be a fair standard of liquid which Gravell considered corrosive and whose corrosiveness he was trying to reduce by application of his metal salts.

I have conducted a great many tests with combinations of materials including acids and metals and also including acids, metals and so-called pickle control substances.

Mr. Owen: Now, have you prepared tables and charts showing results obtained in your tests? A. I have.

Mr. Owen: I offer this book of tables and charts as PX-343.

(The book was thereupon marked PX-343.)

(The witness then explained the data on these tables and the figures on the charts in part as follows:) Instead of taking the first table, I would like to turn immediately to the graph which is the next part of the PX, and the title of this graph is the "Rate of corrosion of mild steel in various concentrations of hydrochloric acid solutions containing 0.0043%, 0.102%, 1.32%, 4% copper chloride." To the left on the graph the legend is "Corrosion rate in pounds loss per square foot per day." Now, the corrosion rate of 35 per cent raw acid, the percentage being across the bottom of the chart, shows a corrosion rate between .60 pounds and .72 pounds. That is, the most concentrated hydrochloric acid has that corrosion rate. Now, moving down in concentration of hydrochloric acid, we find that at a concentration of 30, we have a point where the rate of corrosion is between 1.32 and 1.44 pounds per square foot per day. Moving back to 25 per cent concentration, the rate is 1.32 pounds per square foot per day. Coming down to 20 per cent concentration, the rate is between .48 pounds per square foot per day and .60 pounds per square foot per day. Coming down to 15 per cent, the rate is between .24 pounds per square foot per day and .36 pounds per square foot per day. Down to 10, the rate is a little less than .24 pounds per square foot per day, and at 5 the rate is about the same. Now, that particular set of data shows that different concentrations of hydrochloric acid have different rates of corrosion. Now, when I add copper chloride to that in an amount of 4 per cent, it accelerates the corrosion enormously in the case of the 5 per cent. It does the same with 10 and it does the same with 15.

Q. Is that shown by the dotted line? A. That is the dotted line, so-called number 1, down here. And it goes over, as the concentrations of acid go up, it becomes less than that of raw acid. The legend for that is on the right there. The dotted line is the 4 per cent copper chloride.

Now, if we take number 2, that is 1.32 per cent copper chloride, and number four is .102 per cent copper chloride, and if we take the lowest amount of copper chloride, the 0.0043 per cent copper chloride, we find that it is the most effective concentration of copper chloride to use in hydrochloric acid, compared to, say, the 4 per cent. Now, this is an entirely unexpected result as far as I am concerned. That is, why less copper should be more effective in hydrochloric acid of different concentrations is a point of interest.

Q. Now, Doctor, do these amounts of copper chloride shown in these different curves have any significance in connection with the Gravell patent? A. They are concentrations selected from the patent examples except the 4%. There is no concentration of 4% mentioned by Gravell.

Q. As I understand you these are the percentages of arsenic contained in the different examples, and you have used the same amount of copper in making these curves, is that right? A. That is correct.

Q. And can you identify with the examples which you have marked A, B, C and so forth, in the patent, these different figures so we will have that? A. Yes. Example D which contains arsenic contains 0.102, Example B contains 1.32, Example F contains 0.0043%, Example G contains 1.43% arsenic.

Q. The Example G is not on here then? A. No; Example G is 1.43%. That is not on the chart.

Q. So that the ones on the chart are B, D, and F? A. Yes.

Mr. Lyon: Let's put them on by number, Mr. Owen, will you?

Mr. Owen: No. 2 curve is Example B. No. 4 curve is Example D. No. 5 curve is Example F.

Q. Now let's get back to the table which is the first sheet in this exhibit PX-343. A. In that I have calculated the corrosiveness of these different amounts of copper chloride in the 5% hydrochloric acid. Taking the 5% hydrochloric acid as 100% corrosive it has a rate of 0.174 pounds per square foot per day.

The Court: Where is that? A. In the top line, Your Honor. That is 5% hydrochloric acid without any copper, and has a rate of 0.174 pounds per square foot per day. Now, when I add 0.0043% of copper, the corrosiveness is reduced to 62.7; if I add 0.102% of copper, the corrosiveness is reduced to 68.3. That is the third line in that group. I am reading only the right-hand column.

The next one where I go up to the 1.32 per cent of copper, instead of having a reduction of corrosiveness, I have a definite acceleration of corrosiveness; and the corrosiveness has about 129 per cent that of the raw acid; and when I go to 4 per cent of copper I have got 336 per cent corrosiveness, or, my corrosion runs three times more than it was in the 5 per cent raw acid alone.

The chart, of course, shows the same data, but it is rather hard to read these figures from the chart, and anybody looking down through the columns can see how it varies in these different concentrations of acid.

Q. I note that in the data in connection with the 10 per cent hydrochloric acid, the effect of the different amounts of copper chloride were the same in order as in the 5 per cent group? A. That is right.

Q. But when you come down to 15 per cent hydrochloric acid, then it seems that the additions of any of these different amounts of copper chloride reduces somewhat the corrosiveness? A. Yes, that is correct.

Mr. Lyon: When you get down to 35 per cent, they go in the other direction? A. That is right, and the graph shows that.

The Court: Those that you have just been reading to me are shown by which line on the graph?

Mr. Owen: We have been reading all of the lines on the graph, Your Honor (indicating). It seems harder to follow on the graph than it does on the table? A. That is right. That is why I provided both the table and the graph, because that makes it easier to make some of the comparisons.

Q. Doctor, how many different strip tests did you

make for each of these different concentrations of these acids? A. Well, we made for any point that we show we made three tests; for many points we made 5; and for other points up to 20. It would be impossible to recall just how many we made in any specific case.

Q. These figures that you give in the last column, and in the next to the last column in each of these tables are the averages of those results? A. That is correct.

Mr. Lyon: Have you plotted the averages in making these curves? A. That is correct, Mr. Lyon.

Mr. Owen: I would like to have Your Honor turn back to the first chart, showing the corrosiveness of the different concentrations of hydrochloric acid, and I will ask the witness to point out the most corrosive concentration, and state how the corrosiveness is affected by either higher or lower concentrations from that point. A. The question asked me, where is the most corrosive mixture of the hydrochloric acid, and my answer is that it lies somewhere between 25 and 30 per cent, or a little on both sides of that, that is, I haven't got too many points here, but I have done this often enough to know that that is the data I have.

Q. Doctor, I think you misspoke yourself, you said the most corrosive point was between 25 and 30; isn't it between 30 and 35? A. Yes, but I qualified that by saying my high point is a little above 30; before I would want to be real precise on that I would want more tests. There is no question in my mind of the general phenomenon, but to say that it is precisely one concentration, that is another point. It is in that region.

Q. Now, I want to have you trace this corrosiveness line for raw hydrochloric down to the 15 per cent concentration, which is the one in which we are particularly interested in connection with the Greibe-Sanford patent. I will ask you to state the corrosion rates for 5 per cent, 10 per cent, 15 per cent, and 20 per cent hydrochloric acid. A. The corrosion rate on the 5 per cent raw hydrochloric acid is 0.174 pounds per square foot per day.

Mr. Owen: Does Your Honor know where that comes

from? It comes from the left, those figures on the left. That is at a point between the 0.12 and the 0.24 on the chart.

The Court: All right. A. (Continued): And the exact value is 0.174 pounds per square foot per day. For the 10 per cent hydrochloric acid the corrosion rate is 0.190 pounds per square foot per day. For 15 per cent hydrochloric the corrosion rate is 0.263 pounds per square foot per day.

Mr. Owen: And Your Honor will notice from that point on it begins to go up pretty fast.

The Court: Pretty fast. And it drops off. A. Yes, sir. It drops off on the further side very definitely.

The Court: Yes.

The Witness: The graph C-1658 shows the effect of arsenic in raw hydrochloric acid, when the concentrations of the acid are varied. Now, this graph is similar to the graph on the copper, and you will notice that the raw acid again is the solid line. You will notice that the two low concentrations of arsenic trioxide follow pretty well along with that of the raw acid. No. 1 is the raw acid. The solid line, Your Honor. 2 is the 0.0043 arsenic trioxide; 3 is 0.102 per cent arsenic trioxide. Both of those concentrations, you see, follow along pretty well with those of raw acid, over this concentration range, which is from 5 to 35.

Mr. Owen: In other words, they are not very effective? A. That is what the curve indicates.

The Court: One of them makes it worse and the other a little better? A. That is right, up on the top point.

Mr. Owen: Now, when you come down to 4 and 5, what are those concentrations, and how effective are they? A. No. 4 is 1.132 arsenic trioxide. It is effective except up around 20 per cent. And 5 seems to be somewhat effective, because the corrosion rate now is less than 0.06 pounds per square foot per day, whereas up at the high point on the low concentrations we have the corrosion rate of about 1.44 pounds per square foot per day.

The Court: Well, No. 5 does the best job of all? A. Well, 4 isn't very much behind. They run pretty close. It is a horse race between the two of them.

The Court: I wonder if I could find some theory—when you get an answer that has a very low corrosion rate, you are more likely to get an increase than you are with a high one, isn't that so? A. Your Honor is a braver man than I if you wish to theorize about this data and corrosion rates. I am going to stick to facts. If I get messed up in theory here, I will be at it a long time.

The Court: All right. I agree.

(A volume of Alquist's tables marked PX-344 was handed to the witness. Referring to the table entitled "Corrosion accelerated by the addition of a Gravell metal to a 31.45% hydrochloric acid solution (20 Be') containing the acid regulator indicated," the witness testified:)

This table gives data on 31.45 per cent hydrochloric acid, with an acid regulator added, and I will have to explain about this particular acid regulator. Referring again to the testimony of Mr. Douty, at Ambler, he stated how bone oil is extracted with hydrochloric acid, in order to get a mixture of organic bases in hydrochloric acid, which is a mixture of organic bases in acid. Now, this bone oil was made in that way, that is, it was extracted with hydrochloric acid, the tar removed as described by Mr. Douty previously, and that clear acid solution, that is, clear from any oil, and so on, as well as that can be separated so that it was suitable for use, it was dark in color, and when I say clear, I mean clear of the oily layer, which we removed, and that organic base mixture was added in hydrochloric acid, which I call in the table 0.1 per cent hydrochloric acid bone oil extract. You take the bone oil and extract from it by means of acid the soluble portion, and discard the insoluble portion. When I add that to the acid alone in this percentage I get a corrosion rate of 0.5834 pounds. Now, in all this table the raw acid is 20 Baume.

The next example we used again a tenth of a per cent of hydrochloric acid bone oil extract, with 0.228 tin, and the corrosion rate increased to 1.189 pounds per square foot per day, which is double that of the preceding example. In other words, a lower corrosion rate such as the patent would

suggest in this hydrochloric acid, I got a higher rate of corrosion with this particular admixture. If I add cobalt, I get an increase in corrosiveness in the same mixture of bone oil extract and raw acid with the bone oil extract added thereto. The corrosiveness of that mixture is about 50 per cent to 60 per cent more than that of the first example.

Then I varied the amount of the bone oil extract, increased it to a half per cent, and when I added more of the bone oil extract, I got a decrease in corrosion, and my rate was 0.3277 pounds per square foot per day. If I added 0.228 per cent tin the corrosion rate went up slightly to 0.3606. Now, this data is graphically presented in graph No. C-1748.

The Court: You take away down at the bottom there, where you added 0.5 hydrochloric base, you say it reduced it, you mean comparing the— A. Comparing it to number 1 above in the same table, Your Honor.

The Court: Now, I am not taking the time to look back, but just asking you, how does that compare with the 20 Baume acid alone? A. Well, the 20 Baume acid alone has a corrosion rate, as shown on my graphs yesterday, of 1.41 pounds per square foot per day, compared to this 0.5834 for the—

The Court: In other words, just add that bone oil extract? A. Yes, sir, the hydrochloric acid bone oil extract.

Q. What is bone oil extract? A. Well, as Mr. Douty explains, if you distill bones in that process, you get an oil which is a mixture of a large number of nitrogen compounds, some of them organic bases, some of them organic nitriles, and there are a large number of things in that mixture; that is the bone oil alone.

The Court: That does a better job of inhibiting than a lot of things you had? A. That is true, sir.

The Court: I was curious about it; is that an acid? A. No, that is a mixture of organic compounds. You cannot call it just an organic base, it contains organic bases and it contains organic nitriles, and, for instance, this contains the methylamines, which was one of the amines I mentioned yesterday.

The Court: Have you played with these things enough to tell me if I reduced that down to a half of one per cent, this bone oil extract, suppose I took a quarter, cut it in two again, where would you expect it to go? A. Well, if we varied that amount of bone oil; I think we will find some of that data further on, and I would rather go to those facts than try to clarify that picture, except to say in a general way—

The Court: I haven't found anyone that dared to say anything about these things unless they have run the tests, and I am talking generally about all these subjects, isn't that true, isn't that a correct conclusion? A. It seems to me we have difficult problems.

The Court: And they are justified in it, which seems to show that there isn't much—generally you say if you take twice as much you get at least more of the results you are aiming for, but you are liable to get less. Here I take half as much of this bone oil mixture and I get a greatly reduced— A. No, Your Honor is not quite straight on that point.

Q. (By Mr. Owen): You take five times as much? A. The first one is a tenth of a per cent; I would like to point that out right on your table, so I will make myself clear; that is one-tenth and you take five times the other.

The Court: That is right, that is right; when I add it, it went the right way. A. Yes, for once it did.

The Court: I am glad, I was wrong, and I thought you had taken a half. A. No, sir.

The Court: I got my decimal point wrong, five times as much. A. Yes, sir.

The Court: Well, then, I will just repeat the question the other way; suppose you take one per cent instead of a half a per cent, would you expect it to go on and get better? A. Yes, sir; I will have data like that in the future, I believe, if we haven't taken that particular data out here in streamlining.

The Court: Then as to that one subject it seems to go, but now I was going to go back over here to the first

column, you see. Suppose all of those experiments there had been performed with 15 per cent of hydrochloric, what kind of result would you expect? Of course it would change your standard; that first one is your standard. In other words, what I was really getting at is whether you thought the bone oil acid would have a decidedly different effect on 15% than it would on the other. A. No, they would be both in the same general direction, Your Honor.

The Court: You would take that all the way down too? A. Yes, your corrosion rates in general would be lower. I might get acceleration or might get decrease with the metals added. I would have to see the experiments.

The Court: If I carried it on below they don't keep following down, or if I went up with my hydrochloric percentage it doesn't run uniform from one to 100? A. No. You can't quantitatively calculate from looking at one set of figures what you would get from the other.

The Court: Well, I come over into my middle column here. You think if I increase all of those I would get a better or a worse job? A. Well, I will only refer to my curves on copper. Yesterday I showed when I increased the copper percentage I got very much higher corrosive rates in certain instances, with copper in hydrochloric acid.

The Court: Would that be true of this, you think, as it was for copper? A. I don't know without doing the experiment. But if it was like the copper, then they would go up. If it was like the arsenic, then they would go down. I don't know. I would have to do the experiments. I have some of these experiments further on here.

The Court: I was not criticizing you because you hadn't made enough experiments, but what I was really aiming at was whether there was any formula or theory growing out of this? What is the theory out of the first page? I have a lot of figures. I seem to understand each one as I look at it, and as I look at the one above and the one below, and up here, and I seem to understand it, but when I get all through, I wonder what I have got. You gave me a— if you had a conclusion growing out of these

experiments, what is it? A. Well, I will say it this way that the behavior of these mixtures is unpredictable, and the only way I know of getting to the facts is to make enough experiments to try to make the picture as clear as possible and I would rather go on with the data and come back to that point later if I may.

The Court: Well, now, I have seen so many of these things that I will agree with you—you say if you add one-half per cent butanol you get that, but how do I know if you add more or less, or if you add some other alcohol—that is an alcohol, is it not? A. That is right.

The Court: If you add some other alcohol,—the way these things are going, I just know the ones that I see, or, the one that I see there, and I cannot depend upon his cousin to behave like he does at all. It seems like there are black sheep in the family, and some who distinguish themselves, among a lot of ignoramuses. This is a funny family. A. I have been working on the subject for eight years, and I still do not know all of the points about these things; they are very complicated.

The Court: Now, this occurred to me, how do these acid regulators—they can be divided into different classifications, can't they? A. Yes, sir, and they have attempted to do that.

The Court: Have you been able to work out any classification, general description, according to well known classifications that will tell which are helpful and which are harmful, and which are most helpful; is there anything like that at all? A. Well, I might be proven wrong in some cases, but I will try to answer that question, referring to this chart of Mr. Rebbeck's, talking about what I think is present-day practice, realizing that I do not know all of the different present-day practice. For instance, I would say from my knowledge that the acid resins are very little used in present-day practice. That is No. 7 on the third column of Mr. Rebbeck's chart.

The Court: Well, you are just going to point out the particular ones that are good and bad. I was wondering if

there was some description by metals that were black or white or heavy or light, or ductile or not ductile; is there any general description other than by going right through and putting your finger on something by name. A. Well, I give this as an opinion, and I even hesitate to do that—

The Court: I can see why you do, because no one has stuck their head up in the lawsuit that someone else hasn't been able to knock it down. A. Well, I would say from considering present-day practice, and making it brief, that in general we find that the things on the market that get the use are either in the class of nitrogen compounds or sulphur compounds, or sometimes combinations of those.

Q. (By Mr. Owen): Those are on the market for what purpose? A. For pickling inhibitors. Now, I might be proved wrong on that point; that is just my own personal opinion, and I don't know whether, as I say—

Q. Now, on this chart, PX-337, which items would cover those pickling compounds you have referred to? A. Well, they would come under 22.

Q. That is pyridine bases? A. That is correct. That would be the nitrogen compounds, then of course organic bases are also nitrogen compounds.

Q. That is No. 21 on the chart? A. So I would have to include 21, and I do not want to leave out 20, you see the thing starts to expand.

The Court: Do you mean good to use with metals or good to use all alone? A. I am talking about good to use all alone, which is the practice that is most commonly followed at present as far as I know; there may be some practices where they use the metals. Now, the sulphur compounds here, I don't find them stated exactly, some of them are used.

The Court: Now, when we come to talk about using them with metals, do some of them, some of these that you have in your list that are good to use all alone, help metals? A. Well, the answer to that is the experimental data with the strips seems to show there is a helpful effect, as I have already pointed out on the chart this morning.

The Court: I will put the same question putting it the other way around, and ask would metal help some of them? A. That is the same question; you have the acid with these two things added to it.

The Court: Aren't some of them harmed? A. Some of them are harmed and some of them are helped.

The Court: If it goes for one, it goes for both again, if you put the metal in, or does it, do some of them make the metal better, do a better job than the metal, but not so good as they would do alone? A. Well, the phenomena goes all ways, as that chart shows. For instance, in the chart this morning I showed you where adding some of these organic bases to the arsenic it made it worse, and I showed you cases where it helped, and I even showed you cases where it was better than sulphuric acid.

The Court: Now, there are two questions in that, those that you say some of them make it better and some make it worse, is that result you might be speaking of either the metal or the organic base and it might help—the combination might be better than one and worse than the other; some of them will fall that way, won't they, in between? A. That is right.

(A volume of Alquist's tables was thereupon marked PX-355.)

Mr. Owen (handing PX-355 to witness): Please explain briefly what this data refers to. A. PX-355 refers to tests made on a half gallon container. It is shown in photograph 77,140 in the exhibit and is lacquered on the outside, made of 28 gauge metal, black iron.

The Court: That is something that you made? A. No, I bought it on the market. It is made by the Central Can Company of Chicago.

The Court: It isn't anything that has been used in the oil business here? A. No, but it is a container, as far as I know.

The Court: Yes, it is a container all right.

The Witness: In these half-gallon tests we used 1600 c.c. of the acid, the acid with an acid regulator, or the acid

with the metal salt or the acid with the metal salt with the acid regulator, combinations that we have previously been discussing. Now, these tests were run with the cover laid on the can. In other words, it was vented. So that if there was corrosion, if the iron did dissolve, the hydrogen gas did form, the hydrogen gas could escape and the corrosion continue to take place. Now, the tests are arranged, again, in order—I ran approximately 200 tests. By that I mean more than 200—I don't remember the upper number, and these tests are summarized on these tables and the graphs which accompany the tables.

One time when I had a few minutes to spare I figured you could run about five billion tests on this blooming patent.

(The witness then explained his ½ gallon tests in connection with the tables, graphs and photographs in PX-355.)

(The court thereupon inspected a number of half-gallon drums.)

The Court: I will just put this on the record: I have examined a large number of these half-gallon containers that have been eaten by the acid in them until they leaked, and in practically every instance I can find that that was the weak point in there, by the structure of things, in other words, they are very likely to be where the weld was. They are very likely to be in the seam where the bottom is fastened on in some way, and in one I found that it was not in the seam or in the weld, and it ran decidedly straight down the side, and when I came to examine it, I could see that in some way when that was made there is a seam at that place, or some kind of a damage, and, of course, that isn't surprising to us, because we all know that there can't anything be made like that that doesn't have some spots weaker than others and more subject to attack than others, and so that doesn't explain anything, unless, in a measure, why some of them would, because of their structure, go quicker than others. But we have enough of these experiments so that I think it is safe to say that we can see that

the acid and the inhibitor that was in it had much to do with where they would go to. It isn't all, by any means, explained, in my judgment by just the difference in the metals of all of these. They are as near alike as commercial containers are turned out. I am satisfied they furnish no more multiplicity of strength and weakness and variations of that kind than would be found in commercial containers. Has anybody anything they want to add to the record?

Mr. Owen: I thought that we might mention that in some of them the metal had been eaten away,—

The Court: Yes, in some of them where I have mentioned—in all of them I seem to find that if they leak they had been eaten in seams or defective places. I will say in addition to that I found one that not only leaked in the seam but right through the bottom at numerous places, there are openings that I can see the light through, so that that one it seems evidently held about as well as the rest of it, because it went at both places, began to leak before they took it out, it had eaten enough so it was leaking not only in the seams but right through the bottom in numerous places, and that one, for example, showed that it did go very evenly, because the walls of it, where it is not eaten through, as I feel of it, are as thin as paper. It feels like a piece of ising-glass to my hand as I bend it back and forth and it cracks like a piece of ising-glass would. It is so thin I am satisfied that that one, for instance, if you weighed the before and after this would show a very great reduction in weight, because it went like the old one-horse shay, everywhere.

Mr. Lyon: It might be interesting to have the record show that is the one you just referred to, No. 191.

The Court: 191.

The Witness: Now, before I continue, I probably should explain that I ran half gallon tests, ten gallon tests, and 55-gallon tests, and there are different containers, so there can be no possibility of any mistakes in the work on what the drums are concerned with, I used a system of designation, say ½ number 36, ½ number 10, and so forth.

and on the 10-gallon it was 10-52 and 10-54 and so on, and on the 55's it was the same way. So that would avoid any confusion, if it would possibly occur, which is slight.

The next graph, C-1796, was tests run on 15 per cent sulphuric acid, and with 15 per cent sulphuric acid, one-tenth per cent cadmium sulphate, one-tenth methanol, the life continued for less than 20 hours. With one-half per cent copper sulphate and one-tenth per cent butanol, it lasted a little longer than 20 hours. With one-tenth per cent cadmium it lasted about 35 hours. One per cent cadmium with one-tenth per cent dimethylamine lasted a little over 40 hours. One per cent cadmium phosphate—I mean cadmium sulphate lasted the same length of time.

Q. (By Mr. Owen): And the addition of dimethylamine had no effect? That is, 7 and 8 are the same, except 7 had the one-tenth dimethylamine? A. That is right.

The Court: Except we must keep in mind now that if this difference does come in the container, for instance, there where they are close together like that, they might be just reversed. A. Yes, but you remember that is the problem Gravell purported to solve, sir.

The Court: Yes, I know, but I say the— A. (Interposing): He was faced with his containers, and if they were iron containers, they had these properties at that time as well as on my tests.

The Court: For instance, they are close enough together so that the one per cent cadmium sulphate in number 6 and number 7 might have been reversed sometimes in your tests, I take it? A. That is right.

The Court: I just was calling attention to the—how with the same test they jump around so widely. A. That is right. I have shown that repeatedly.

The Court: And that is all fair on your part.

Q. (By Mr. Owen): Doctor, I would like to ask you right in connection with the remarks of the court, whether the character of the corrosion in these various drum tests was the same, in other words, was it equally eaten all over, or was it a different type in some places? A. Well, Mr.

Owen, I dislike to answer that question without having carried out more detailed observation. Now, for instance, I can find one like His Honor mentioned, where it crumbles all down all the way around, and it has been eaten out quite badly, and you can definitely say there has been an even type of corrosion. But where you weigh one up and don't make the determination of just where that much of the weight is, you would have to be indefinite on that point. For instance, what are you going to say, you have one that goes out two hours, ping, and in one certain spot, and that is all. That don't have much chance to corrode evenly all the way around. It corrodes all in one spot and is gone. That is one of the things in Gravell's problem.

The Court: The one that went out quickly probably didn't reduce in weight as much as though it had gone a long time and ate more evenly. A. That might be.

The Court: Probably. A. Sometimes they might not, but these, some of them, lasted a long time and had small losses in weight and just pinged out in one spot.

(A book of tables, graphs and photographs relating to the 10 gallon and 55 gallon tests was offered as PX-356.)

The Court: I never saw so many tests in my life.

Witness: Well, what is a fair sample of five billion, Your Honor?

The Court: I don't know. I would answer like so many have. A. I would say that too; I don't know.

(Witness continuing): Now, the first part of this book contains the Interstate Commerce booklet description of the containers which they call the 5A container. This container I am going to describe in the tests is shown in Photograph 77142. I have one over here (indicating) and that is called the 10 gallon I. C. C. 5A Drum. The next photograph is one of the test chambers which I used to conduct these experiments in. When I started out on these tests I would fix up the drums with the gauge on them, as suggested by Mr. Douty previously, and placed the containers in what we call the fume cupboard in the room and let them do their stuff. It happened one night one of the boys tak-

ing care of the observations for me went in there, looked at the pressure gauge, made a record, and just as he walked away the drum let loose, knocked the door of the fume cupboard loose and after that he was chary. He told me in no uncertain terms I better fix it up better for him. So we constructed a special chamber in which we have taken out some of the hazard of this operation.

The Court: Sounds like one of those bomb-proof cellars.

(Witness continuing): This room was constructed with the heater in the position shown in the top of the photograph with the light in the same position, situated as far from the testing drums as we could, so I wouldn't overheat the drums. I tried to hold the temperature at 35°C. the same as I did the others.

The Court: What is that Fahrenheit? A. 95°. And then I put my liquids in the drums and then attached the small pipes to the drum and then put the pressure gauges which the boys had to read on the outside as shown in the next photograph. The photograph, which is 76645 shows one side of my drum hut, as I will call it, with the pressure gauges on the outside. You can see there are six pressure gauges, and then the thermal couple coming out of the middle run goes behind, a continuous record for the temperature.

The Court: I take it we are getting ready to make a test of acid pressure in a steel drum? A. That is correct. And the door on the front of this drum hut was made out of safetyglass so we could look inside and see what was going on. That is at the bottom of the photograph as it is placed in the book here. I should say so I will not be misunderstood, these photographs were taken with no acid mixtures in the drums. We didn't wish to expose the photographers to any danger. This shows the setup before it was actually used.

I would like first to refer to photograph 76735, the first one right before the first table. That gives you some indication of what happened on some tests when these drums

let loose; this door, you can see there (indicating), they were so set that they could let loose without taking the shanty with it, that is, break the door. You can see that the pressure is off the gauge, and you can see the gaping open hole in the bottom of the can as it lay in the doorway. The container was like this one here (indicating), pretty heavy. It weighs about 25 pounds, holds about 10 gallons of acid, and is 16 gauge metal.

(The witness then explained the tables, graphs and photographs in PX-356.)

Drum 10-68 failed in three-quarters of an hour. The pressure reached 38 pounds. It leaked in the bottom seam. We have a graph of that which I will refer to. The graph says Drum 10-68, the acid was 20 Baume hydrochloric acid, there was no metal added, no regulator added, the drum failed in $^3/_4$ of an hour. The average temperature was 35°C. The graph is No. C1545-A, and the pressure went from zero pounds to 38 pounds in that 45 minutes. The curve in the graph is the pressure curve. That shows how that pressure went up. For instance at the end of about 30 minutes the pressure was over a little less than 30 pounds.

(Referring to the table on page 37 of Exhibit PX-356, entitled "10 gallon drum corrosion tests with 20° Be. hydrochloric acid plus metals and acid regulators" the witness testified:)

The next group of tests is 10 gallon drum corrosion tests with 20 degree Baume hydrochloric acid plus metals and acid regulators. Now test on drum 10-65 contains 0.21% cobalt and 0.5 normal butanol. The drum failed in two hours. The maximum pressure was 62 pounds, and it leaked in the bottom seam. Another test was 10-64 with 0.23% cobalt and it had .5% normal butanol, an alcohol. It failed in 2 hours. The maximum pressure was 66 pounds. On drum test 10-92, it contained 1.05% tin and 0.3% gelatine, and this first drum lasted 5.2 hours and had a maximum pressure of 52 pounds. There is another one at 0.105 per cent tin against 0.3 per cent of gelatine, and this lasted 5.5 hours and the maximum pressure was 57 pounds. The

first one, the head blew out, and the second one leaked at the bottom seam.

You will recall that Mr. Gravell in the patent makes the statement that he prefers tin or arsenic. He makes that statement on line 43, and also makes that statement in the paragraph beginning with line 98, "or acid solutions containing an acid regulator"—in this case my acid regulator is gelatine. It has been known for a long time that gelatine is an acid regulator for pickling material. Then he says, it needs only the addition of tin. I tried to do what he says, in one of his preferred examples, and my drum lasted for 5.5 hours. My next test was 10-78, with 0.22 per cent nickel and 0.1 per cent hydrochloric acid bone oil extract, and the drum lasted 11.6 hours. The maximum pressure was 55 pounds, and it leaked in the bottom seam. And this hydrochloric acid bone oil extract is an organic base admixture. The next one I added 0.24 of a per cent tin to this hydrochloric acid bone oil extract, it lasted 12 hours, and the maximum pressure was 53 pounds, and it leaked in the bottom seam. The next test, 10-77, I used 0.16 per cent cobalt with a tenth of a per cent of hydrochloric acid bone oil extract. The drum failed in 16 hours. The maximum pressure was 57 pounds, and it leaked in the bottom seam.

I might mention what I mentioned before, and say this, that if you look back in your first table you will find some of my low numbers, and I told you that I had the drums on their sides, and I would not be surprised if around these bungs, and so on, where the metal is more strained, it would be more apt to corrode. That is one of the theories they use, but I don't go so much for theories. I would rather have it in practice.

By Mr. Owen:

Q. How were the drums located in these 10 gallon tests? A. In all these tests, the conditions were more uniform than in the earlier tests. But in shipping you do not have them always in an upright position, you may have them in any kind of a position.

Drum test 10-83, I used 0.21 per cent tin. That drum

lasted 17.4 hours. The maximum pressure was 64 pounds, and the head blew out. The next one had 0.24 per cent tin, that is drum 10-84, it contained 0.5 per cent of hydrochloric acid bone oil extract, it lasted 24.6 hours, the maximum pressure was 55 pounds.

The Court: I call attention to the fact that when we had the same amount of tin up above without this, it went out in 12 hours, practically half the time that it did with the increased amount of bone oil, the bone oil when it was one per cent it went out in 12 hours, and when it was 5 per cent — A. It is one tenth and five tenths.

The Court: One tenth, yes, but the increase of bone oil is the only difference I can see there, the tanks held about equally well, they went out at the same pressure, about? A. That is right.

Mr. Lyon: An extract is only partly bone oil, Your Honor.

The Court: Well, whatever that is, it was the same in both cases? A. That is right. It was the same batch of stuff made according to Mr. Douty's described process.

The next one we used 0.27 per cent cobalt, 0.1 per cent bone oil, and that drum lasted 25½ hours, the maximum pressure was 60 pounds, and the head blew up. Now, the next test, No. 10-90, contained 1.14 per cent tin, 2½ per cent by volume monoethylamine and 22½ per cent by volume diethylamine, the drum lasted 29¾ hours, the maximum pressure was 63 pounds, and it leaked in the bottom seam. Now, this particular mixture here is similar to that first one in the patent, that is a mixture which Mr. Gravell says has to be shipped in glass. That is the one-quarter by volume of these organic bases, you see that adds up to 25 per cent.

Q. That is example A, with tin substituted for— A. Well, it is example A, so far as the bone oil—I mean the organic base and the acid is concerned, and then when I am adding the tin, I am adding the tin in place of the arsenic in example No. B; is that point clear?

The Court: This is really B? A. That is right, it is really B, and when I was talking about the organic base

with the acid I said that was composition A, but that lasted $29\frac{3}{4}$ hours. I am sure I couldn't ship a drum of that to China in $29\frac{3}{4}$ hours.

The Court: How does this compare with the one without that added, though, where is that, that we would have to turn back for, you have that somewhere? A. No, I don't know whether I do or not; I will discuss that a little later when I show you the graph, and so on.

The Court: All right.

The next test, No. 10-89, contained 0.48 per cent tin and 0.5 per cent hydrochloric acid bone oil extract. The drum lasted 32.3 hours, the maximum pressure was 55 pounds. Test No. 10-76 contained 0.20 per cent cobalt, half a per cent of hydrochloric bone oil extract. The drum lasted 32.4 hours and the maximum pressure was 56 pounds. It leaked in the bottom seam. The next one contained 0.26 per cent arsenic and 0.0057 gelatine distillate. It lasted 563.2 hours, the maximum pressure was 54 pounds.

The Court: Old arsenic is the stuff, isn't it? A. Well, the drum failed.

The Court: It failed, but that was— A. That is 600 hours. It is about 15 days. I certainly wouldn't recommend the use of a proposition like that.

The Court: No, more than that? A. Wait a minute. It would be about 25 days. I haven't got my pencil. It is less than 30 days, I know that, because that is 720.

Mr. Lyon: It only had .3 per cent of arsenic in it. And practically no gelatine. A. That gelatine distillate is pretty hard stuff to make. It foams and sputters and fusses, and you can't buy it on the market. You have to make it yourself. I didn't have very much of it to test.

The Court: That held pretty near 28 days? A. That is right.

The Court: Run through February. A. And the next test was with .3 arsenic, the same amount of gelatine distillate, and it lasted 667 hours, and the maximum pressure was 46 pounds.

Now, I have some tests running now in which I put in

1.32 per cent arsenous oxide, 25 per cent by volume of Barrett's commercial pyridine base No. 2. Now, if you will recall my strip tests, that Barrett commercial pyridine base No. 2 was a mixture of commercial inhibitor sold on the market for such use. I am using one-fourth by volume of that as prescribed in the first example. I mean the first example on page 2 of the patent, which is a very high percentage of organic base, and I am using the same amount of arsenous oxide that is called for. And that test was started on the second day of July and it is still in progress, and I can't report the failure time. However, you can figure the time that the drum has been running by going through the 2nd of September, and that is about sixty days.

Mr. Lyon: 64 days. A. 64 days. Yes. But that stuff has sure got a lot of organic base in it. I certainly would not want to use that for anything except a pickling inhibitor. Those things you can buy on the market. They are one-third organic base of the pyridine type, one-third acid and one-third water. You can buy them on the market. And they contain no metal salts. They are just sold as such alone, and that is one thing about that test that I don't know the answer to. These organic bases last a long time by themselves. I get the arsenic in there and I don't know whether it is the effect of the arsenic or the effect of the organic base. If you go back to my half-gallon tests with the organic base admixture with acid, it lasted me, what was it, about 1440 hours, something like that.

Mr. Lyon: When you say those tests are still running, that No. 31, you mean that that stuff has been in the barrel, in those drums since the 2nd day of July and the drums haven't failed yet? A. That is right.

The Court: Haven't failed yet? A. That is right.

Mr. Lyon: Still in it? A. That is right.

Mr. Lyon: You have a pressure gauge on it? A. There is pressure on the drums.

Mr. Lyon: Well, how much? A. I looked at those drums this morning, and they are running along about five pounds pressure.

Mr. Lyon: Only five pounds? That is Mr. Arsenic operating with the well-known organic base inhibitor, isn't it?

Mr. Owen: Well, is it Mr. Arsenic operating? A. That is the question that I don't know the answer to.

Mr. Lyon: It has arsenic in it. A. Yes, but for years we have been buying bases with acids and waters in them in iron drums without any arsenic in them, ship them around and use them.

Q. (By Mr. Owen): In what? A. Ordinary drums.

Q. Name some of them. A. Barrett's pickling compound No. 3. 1/3 pyridine bases, 1/3 sulfuric acid, 1/3 water.

Mr. Lyon: Pyridine is not an acid solution. A. That solution is acid and I have tested it.

Mr. Lyon: Is pyridine a corrosive acid? A. I didn't say pyridine was. I said that is Barrett's description of the material we buy from them in iron drums all the time—it is regular commercial practice. Here I got a proposition of the effect of that high, high amount—that is a tremendous amount of organic bases. For instance in pickling practice they use very small amounts, less than 1% of the pickling inhibitor; that is common practice. They don't use 25%. This is a concentrated pickling inhibitor I have under test here. It is not comparable to the other tests. It was part of the patent and I wanted to have information on it.

Mr. Lyon: I would like the record to show this test has been running now over 1500 hours and the drums have not failed.

The Court: The point I am wondering about is you said you didn't think that would be good to use as a practical inhibitor. A. I just ask Mr. Lyon if he would shove that mixture down into an oil well.

The Court: I take it you say not. Why not? A. Mr. Lyon, would you shove this mixture 108 or 109 down into an oil well?

Mr. Lyon: I would have to ask my expert about that. I don't know enough about it.

The Court: For what reason? I know you have a reason. A. Yes, economically that admixture is much more expensive. The formula will function in the well. So from that point of view it can't be considered as an inhibiting acid. It is a pickling admixture. That high percentage of organic bases is a pickling admixture—1/3 pyridine bases, 1/3 sulfuric acid, 1/3 water. That is what they sell and what we buy.

The Court: You don't put anything down into the well that would do such a complete job of inhibiting? A. That is my opinion, sir.

The Court: What you are using wouldn't inhibit to the extent this does? A. That is another question.

The Court: Any of you. I didn't think any of you went to that extent. A. If you take the regular mercaptan inhibitor which we use, its corrosion rate is similar to this admixture here. We only use less than 1% of that.

The Court: I mean after you get it in it wouldn't come into this range? A. It will come within that range, Your Honor,—

The Court (interposing): If you put it into these barrels, wouldn't it have acted quicker than this? A. I have some data—I wouldn't want to be too precise about that, but I think that I could find it, but they will last somewhere in this same range.

The Court: There isn't anything in this record, is there, which shows the extent to which it inhibits?

Mr. Owen: The patent example is in the record. But there is nothing in the record to show to what extent it inhibits.

Mr. Lyon: I think the witness started to answer that the inhibited acid, as employed by Dowell, with these mercaptans in it, would last in these drums just about as long as this test 31 that you were just looking at, wouldn't it? A. Yes, and there is less than 1 per cent by volume of the material in there.

The Court: What is that?

Mr. Lyon: They have got just about as good an in-

hibitor as is represented by this test No. 31 with the arsenic or the pyridine, as I understand the witness' testimony.

The Court: I did not understand him to say that. I got the notion that it would not inhibit as good as that; if you put it into a drum, it would not stay in there without blowing up, as soon as this did.

Mr. Lyon: I know Your Honor has that idea, but the witness has testified to the contrary.

The Court: Is that right? A. Yes, it is my idea that it would come in this same range.

The Court: You have tested that, I suppose? A. No, sir, I have not tested that. I know that on my strip test, the data is comparable to this, and from that I have difficulty in making a prediction, but I would predict that a drum will blow up, from my strip test data.

Mr. Owen: I wish you would find the book about your strip test data, where you use the bases alone without metals and acids, and show the length of time, or the rate of corrosion, rather, if you can find that? A. Yes, I can find it.

Mr. Lyon: I want to make that clear, while I have the opportunity, that the plaintiff in operating uses an inhibitor which is around 99 per cent complete, and actually—

The Court (interposing): I think you are talking about their advertising, and they indicated that maybe that was too strong.

Mr. Lyon: I think they said that, but that they did it for tactical purposes, but factually I think that is true.

The Witness: Mr. Lyon, I am just merely indicating that if you have that low rate of corrosion which we get on strip tests, that I would predict the drums would have a long life. I haven't tested a comparable test.

Mr. Lyon: I understand, but you do know the rate of corrosion of the mercaptans employed by the plaintiff.

Mr. Owen: He is looking for that now. A. If you take these pyridine bases of Barrett, which I was talking about, going back into PX-344, one-half per cent of these pyridine bases of Barrett gives a corrosion rate in 20 Baume of 0.133 pounds per square foot per day.

Q. Which one are you referring to, which example? A. I am referring to that (indicating). Way at the bottom, 32?

Q. That has no metal in at all, has it? A. No, that is just the bases alone.

Q. In 20 degree hydrochloric acid?

Mr. Lyon: Are we getting off of the subject now? I thought he was looking up the corrosion rate of the mercaptans employed by the plaintiff. A. Oh, no, that has no bearing on this patent and I haven't got any of that test data here at all.

Mr. Lyon: You haven't got it here, but you do know the corrosion rate of the mercaptans employed by the plaintiff is way up in the same figure with these solutions using the amounts of arsenic and pyridine which is shown in this test 310, your latest exhibit? A. It is in that range, somewhere in that neighborhood, but I don't know the exact figures, and I don't know it by this particular concentration of acid; I am just using my imagination.

Mr. Owen: Now, this Barrett compound that you have been talking about, in what proportions is that used as an inhibitor? A. Well, it is used in less than 1 per cent.

Q. And what is the large use of it, the most extensive use of it? A. Well, it is used in pickling, that is the big use.

Q. Do you know how long it has been on the market? A. No, I cannot say that I know how long it has been on the market, but that type of material has been available for a long, long period of time.

Q. Do you know whether it is made in a manner somewhat similar to that set forth in example "A" of the Gravell patent? A. Well, it fits that description, that is, it is an organic base mixture, so it fits that description.

Q. Do you know what acid it has in it? A. Yes, usually the admixture that I was talking about that is shipped has sulphuric acid mixed with these pyridine bases, but this particular one I used here is just a pyridine base, it has no water or no acid added to that, that is a straight

pyridine base alone admixture; I mean just the pyridine base, no water and no acid, as you buy that on the market.

The Court: Let me ask you this; does part of the inhibiting force of this combination result from the fact that it has also destroyed it as acid to eat anything? Of course I could inhibit stuff if I didn't want to eat rock, I don't know, put in maple syrup, I guess, and reduce the amount it would eat the iron, but I didn't understand that is the true definition of an inhibitor. I thought it meant it left the acid just as active on the rock, for instance, as it was before, but inhibited it from eating the iron; isn't that the way it is? Now, I am just wondering here if a part of this inhibition resulted from simply putting in so much of it that you didn't have very much acid, comparatively? A. That is correct; if you start out with this 20 Baume hydrochloric acid, which we started out with, and add this volume of the pyridine bases, I have found that the acid is approximately 17 per cent concentration, and you neutralize your acid by means of your base just as usual; that is, you form a salt.

The Court: I don't think of that part of it as an inhibitor effect? A. No, that is, just as you said, weakening your acid, using up your acid otherwise.

The Court: Well, now, do I understand here of this, if we call it an inhibitor in here, that it is 75 per cent acid and 25 per cent this stuff? A. That is correct, that is the example "A."

The Court: I say that will explain some of the inhibition, I think? A. Oh, yes.

Mr. Owen: But when you put in 75 per cent of hydrochloric acid with 25 per cent of these pyridine bases, how much of the hydrochloric acid remains after the reaction? A. 17 per cent of the acid still remains.

Mr. Lyon: Wait a minute. I would like to have it cleared up, what he means by 17 per cent of the acid, instead of being 20 per cent it is 17. A. Well, let me draw you a picture.

(Witness drawing diagram on blackboard.)

A. If that is all of my acid at the start, let it be all

31.45 per cent acid. Now, you can imagine it this way: That when you put this organic base in there with that, that it takes about just half of that acid to take care of the organic base, just about half of it. It is 17 per cent instead of 15. If it was half it would be about 15.7. In other words, the organic bases use up the acid, and the mixture itself contains one-fourth of that organic base. I don't think of that as an inhibited acid. I think of that as a pickle inhibitor. That is what it is. That is the business that the American Chemical Paint Company was in, and that is the thing that they wanted to ship. They weren't shipping inhibited acid. They were shipping pickling inhibitor, as I understand their problem.

The Court: Part of it is inhibited, and part of it is diluted, isn't it? A. That—well, yes, I think I see what you mean by that statement.

The Court: Part of it is putting a coat on the wall. A. Well, let me do this. Let me continue to put this organic base in here. If I put more organic base in, after a while my mixture is alkaline. These agents take the—you see, you have got two points here. You have got the point—

The Court (interposing): With enough, you wouldn't have anything? A. If you put enough of that in it is alkaline.

The Court: You wouldn't have anything to eat the limestone rock? A. That is correct.

The Court: Yes. A. Now, the point I am making is that the usual practice in the use of inhibitors, as I find it in the art, as I have used it in our laboratory testing, is one per cent is high.

The Court: They can use it that way, but it seems that the arsenic in there, this one has an inhibiting effect, and at the same time every bit you put in, even if you put in one per cent of that, to that extent you reduce its strength, the strength of your acid, I suppose? A. Yes.

The Court: To that extent? A. That would be true.

The Court: Of course, you get around where you put in 25 per cent, and you have increased it proportionally, the

acid strength is, isn't that right? A. You have decreased it.

The Court: You have decreased the acid strength? A. That is right.

The Court: According to your solution.

Mr. Owen: Suppose you start out with 15 per cent hydrochloric acid in that example A of the patent, and put 75 per cent of that in with 25 per cent of these pyridine bases. How much acid would you have left, if you put it down an oil well? A. I could make a quick guess. The thing would be alkaline and it would be useless as a limestone solvent.

Mr. Lyon: May I ask a question, Your Honor? The plaintiff today has given us a list of the things it has added to its acid, and along with its inhibitors, and what about these Barrett materials, aren't they the very thing that you are talking about, these pyridine bases? A. They are similar.

Mr. Lyon: I mean, the plaintiff itself is using these very things we are talking about, or has used them. A. That is correct, but we don't use them with arsenic.

The Court: You are asking a question and you haven't answered it. A. We don't use them with the arsenic.

The Court: It isn't in the record.

Mr. Owen: We don't use 25 per cent.

The Court: As I understand it, you asked me, or somebody here, what per cent the plaintiff is using, and my answer is that if it is addressed to me, you haven't proven it. What per cent of that? You tell us that you put it in, but you don't say how much.

Mr. Owen: You mean we haven't proved how much our acid is inhibited?

The Court: What per cent?

Mr. Owen: I didn't understand.

The Court: I say, the question came up about something that is in yours, and I understood Mr. Wiles to say how much of that do we put in, and I say well, you haven't proven it in the record. The record doesn't show it. And I think that is right.

Mr. Owen: We will be glad to have Your Honor have that information. I didn't think that that was a part of our case and necessary to prove.

The Court: Well, it just came up here. Isn't that the question you asked, Mr. Wiles?

Mr. Owen: Well, I think I am safe in saying that we don't use more than around one per cent. It is down in the low figures. I don't know.

Mr. Wiles: That is the point.

Mr. Owen: Yes. A. And we don't use arsenic with it, or tin or any other metal.

Mr. Wiles: When we use it we use it alone.

Mr. Owen: What we do, when we buy these commercial bases they are manufactured by different companies, aren't they? A. That is right.

Q. And sold under different names? A. Special products.

Q. And shipped out in steel cans or steel containers? A. That is right.

Q. Drums? A. That is right.

Mr. Owen: We buy them and we put them in our 15 per cent commercial acid, somewhere around one per cent of these commercial inhibitors.

The Court: How long have those things been on the market? A. Well, I don't know. I can find out. But I think a number of years they were on the market. They are on the order of this Rodine mixture that the—

The Court: How long—they are inhibitors, aren't they? A. They are inhibitors.

The Court: How long have inhibitors, as such, been a commercial article that they have sold? I know they have known for a long while about them, the chemists have.

Mr. Owen: I am sure they were sold to the pickling industry long before the Gravell patent in suit. Gravell's company was selling—

The Court (interrupting): The same kind that you speak about that you are buying?

Mr. Owen: Substantially so.

Mr. Wiles: Your Honor, we can say at least Mr. Douty testified that they were selling Rodine without any arsenic in it as early as 1923.

Mr. Owen: That is right.

Mr. Wiles: So we know that has been on the market that long. I don't think they were the pioneers.

The Witness: The curve C-1830 summarizes the tests I made on ten gallon drums containing 20° Baume hydrochloric acid solution and a metal or a metal and an acid regulator.

[illegible]

hours. Minimum failure time was 21 hours and maximum failure time was 55.

Mr. Owen: What were the minimum and maximum pressures on that? A. The minimum and maximum pressures seem to be between 30 pounds and 50 pounds. You can't arrange them in order according to pressure and according to time.

The Court: No. A. The time is the thing I was considering more specially. So that the pressure element, 50 pounds is on test 10-72 and 30 pounds is on test 10-36.

Mr. Owen: Now, what does the data on this sheet show in comparison with these blanks? A. Well, it shows that some of these metals have a shorter life. The metal on test 10-50 was nickel, and we had a time of 20¾ hours, maximum pressure 56 pounds and it leaked in the bottom seam.

Q. Both of those failed quicker than the shortest failure of the blanks, is that right? A. Well, if you are talking of the average blank time.

Q. No, I am talking about the shortest blank time which was 21¾ hours and the tests of the same acid plus nickel failed in a shorter time than that. No, I am sorry—one was 22.1— A. That's right. You can say that for one but not the other.

Q. And the maximum pressure on these tests with the nickel exceeded that of any of the tests with the blank acid? A. That is true. The pressures were higher in those two tests.

Q. How about the next test with copper? A. Next tests 10-29 and 10-30 both were .15% copper. One lasted 23.9 hours and the bottom blew out. Now, when I say "blew out" I mean the ends of the drum. It may be one end or it may be the other, in some cases, depending on where the point of failure is. In cases where I offered photographs it is obvious the bottom blew out; in other cases not quite so obvious. I don't intend to distinguish between which end of it blew out.

Q. It depends on how the drum is standing in your test I suppose? A. That is true, too. These two tests on 10-29 and 10-30, both with 0.145 per cent copper, one lasted 23.9 hours, the other lasted 30.75 hours. The maximum pressure on one was 35 pounds, the maximum pressure on the second one was 32, that is 10-30.

Q. Now, Doctor, I would pass those two nickel tests following because we have already had nickel, and go down to the one numbered 7 with the arsenic? A. No. 7, 10-104, we had 0.102 per cent arsenic with 0.053 per cent pyridine base mixture, Interlake Iron Corporation, and the container lasted 233.5 hours, the maximum pressure was 17.5 pounds, and it leaked in the bottom seam. And, 10-03 was a duplicate test, as far as the amounts of arsenic and pyridine base are concerned, and it lasted 285.8 hours, the maximum pressure was 14.5 pounds, and it leaked in the bottom.

Q. Now, compare those with the next set of tests numbered 8 in which arsenic alone without any pyridine base was used. A. All right.

The Court: I am still back a little. 8 is the same thing with arsenic, compared with the hydrochloric. Yes, hydrochloric. The same experiment without arsenic.

Mr. Owen: Well, in the other table, test No. 31 had 1.32 arsenic oxide and 25 per cent by volume—that isn't a comparative test, because it has so much of the base. I will take the next test before that. 32 had .26 arsenic and .0057 gelatine distillate, and it failed at 563 hours. And the next test had .3 arsenic and the same amount of gelatine distillate and it failed in 667 hours.

The Court: All right.

Mr. Owen: Now, Doctor, compare these tests numbered 7 and those numbered 8 on this table with phosphoric acid and point out the difference in results of the test No. 7, being a mixture of arsenic and pyridine bases, and test No. 8 having only the arsenic? A. On test 10-52 0.19 per cent arsenic was used. 10-51, 0.19 per cent arsenic was used. 10-52 lasted 948 hours and 10-51 lasted 639.8 hours.

Q. In both of those only the arsenic was used? A. That is correct. The comparison there is arsenic with organic base against arsenic without the organic base.

Mr. Lyon: Did you point out that in the test with the arsenic with the organic base you had only about half as much arsenic as you did in the other test? A. The figures are here and I have stated the figures.

Mr. Lyon: You did not point that feature out? A. I hadn't gotten to that point, Mr. Lyon.

The Court: Can't do it all at once? A. It is all there.

Mr. Lyon: No.

The Court: Because there are so many things in here you can't—

Mr. Lyon (interposing): Well, I thought the witness had concluded and said that was a comparative test with and without the organic base. Of course, I wanted him to point out that in the one test there was almost twice as much arsenic as the other.

The Court: That is right.

A. And on these we had a leak at the bottom seam on one, and in the other the bottom blew out. The pressure on one was 9 pounds and the pressure on the other was 14½ pounds.

(The witness then explained his tests with two types of 55-gallon drums, one known as ICC 5E, being a light weight nonreturnable drum weighing around 55 pounds, and the other being known as ICC 5A drum, made of standard 18 gauge metal and weighing about 110 pounds. The results of these tests are shown in a table appearing on page 158 of PX-356 entitled "Failure Time of ICC 5E and

ICC 5A 55-Gallon Drums containing Hydrochloric Acid Solution With or Without a Metal or an Acid Regulator.")

Mr. Owen: Doctor, have you made any tests with a view to determining the loss of strength of 15 per cent hydrochloric acid during extended periods of contact with the inside of a piece of oil well tubing? A. No, I have not made any tests with oil well tubing, but I have made tests on pipe.

Q. Will you explain what tests you have made, and what pipe you tested? A. I just took the ordinary kind of pipe that we use in the plant. I have here a blueprint of the type of apparatus that we used. We had a bath here that we could control the temperature by. This data consists of two tables, four graphs and a blueprint showing the apparatus used. These are clipped together and offered as PX-357.

(Whereupon the documents above referred to were marked PX-357 by the reporter.)

(Witness): First I wish to describe the pipe that we have here. The test section where we tested the acid solution was a 2" diameter so-called extra heavy steel pipe, 20" long, of welded construction. That is, it was welded on the top and on the bottom, regular, extra heavy pipe. Then that was fitted by lines to a trap and back to a nitrogen cylinder so it could be put under pressure if we wished to run the test under pressure. I will start in on page 2 of the tables, test No. 1. The time of the test was $21\frac{3}{4}$ hours, temperature maintained was 43°—maximum was 48, minimum 40; the pressure was 1000 pounds. The 1000 pound pressure was put on the acid by means of nitrogen gas, so that the acid was under that amount of pressure under test.

The Court: Now, you have turned to the second sheet? A. Yes, I have turned to the second sheet. Maximum pressure at any time during the test was 1080, minimum 980. The analysis of the solution after the test (it was 15% before the test) was 0.014% hydrochloric acid, and the per cent iron was 10.62; the sample was taken at the end of the

time. Right next to that we have a test which run for 24 hours.

The Court: Now, that says percentage of iron. That means percentage of the mass of iron? A. That is the percentage of iron in the acid solution at the end of the test. The 15% acid, as you can see from the first figure there is used up so that all of the acid is practically gone.

The Court: The rest of it is water? A. That is right. Practically a solution of iron chloride when we get through with the test.

The Court: The water— A. With a salt.

The Court: Iron chloride? A. That is right.

The Court: In solution? A. That is right. Now, the graph that shows that data there has simply, of course, got our two points; we started with 15 per cent acid and at the end we had one hundredth of a per cent acid, and the iron was approaching zero at the start, and at the end it is about 10 per cent, so that shows the way the phenomenon goes, the acid getting weaker and the solution of iron salt keeps getting stronger.

The Court: And the place where it is getting the iron is getting lighter, the thing it is taking the iron off of is getting lighter? A. That is correct.

The Court: Thinner? A. That is correct.

Mr. Lyon: May I ask a question? Referring to the blue-print you just had, how big was the pipe? A. The pipe was a 2-inch diameter pipe, 20 inches long.

Mr. Lyon: How big a hole did it have in the 2-inch, is that inside? A. This is the inside diameter; no, we made these smaller here when we made these connections.

Mr. Lyon: What I mean is this, is the 2-inches outside pipe or 2 inches inside pipe? A. The custom on that, that is the way it is designated; I believe that is the inside diameter of the pipe.

Mr. Lyon: Just give me this data in here, how much acid did the pipe hold? A. (Referring to paper): I am getting to that; in test No. 1 I put in 581 c.c.'s of 15 per cent hydrochloric acid.

Mr. Lyon: And that same acid stayed in there for $21\frac{3}{4}$ hours? A. That is what the table states? That is what we did.

Mr. Lyon: Well, will you just tell me how much you put in on each of the tests and how long you stayed there, the same acid? A. We put in fresh lots of acid on each test.

Mr. Lyon: The same amount? A. And the amount was the same.

Mr. Lyon: 581 c.c.'s of 15 per cent hydrochloric acid? A. That is correct.

Mr. Lyon: And that acid stayed in there, that same acid remained for the full time indicated for the tests? A. For each of the tests, that is right.

Mr. Owen: Now, have you explained that some of these tests were made at atmospheric pressure and others under high pressure? A. I had merely described one test that was made under pressure and hadn't got to my description of the test without pressure.

Q. Well, you go ahead and explain the others, will you, please? A. Now, the next test was made at atmospheric pressure, the temperature range on that was from 40 to 46, and we tried to maintain a temperature of 43.

Q. What would that be in Fahrenheit? A. About 110 is what I calculate that at. Now, that one went down to 0.012 per cent acid and the iron went up to 10.29. Now, it was possible on that test to take out small samples for analysis, which we did, to give some picture of how the acid behaved over the time period. It is not as convenient to do that and keep your test at 1000 pounds pressure, so we started out with the 15 per cent acid and at the end of about three hours the acid was down to about 11 per cent. The iron was up to 3 per cent. At the end of 6 hours the acid was a little over 8 per cent and the iron was up to 4 per cent. At 9 hours the acid was down to 7 per cent and the iron was up to $5\frac{1}{2}$. At 12 hours the value on the acid was about 5 per cent and the value on the iron was about 7 per cent, and you can follow along on the curve and see how

that change goes until we reach the end point at the end of 24 hours.

Now, test No. 8 was running under a 1000 pound pressure, and instead of running at 43 degrees we ran down to 30 degrees. Now, 30 degrees would be about 85 degrees Fahrenheit. The graph is labeled test No. 8, Your Honor, and it is the second one from the blue-print.

The Court: Oh, yes. A. Then on test No. 8, we ran that for 24 hours. We tried to maintain a pressure of 1000 pounds. The maximum was 1060 and the minimum was 960. The hydrochloric acid went down to 4.6 per cent and iron went up to 7.04.

Then we ran a similar test at the same temperature, which was about 85 degrees for 24 hours, and the acid came from 15 per cent down to 6 per cent and the iron went up to about 6 per cent, and the data that I have just described in the table is graphically presented in the curves on test No. 8 and the test on No. 7, going to a little more detail on No. 7. I would like to discuss the curve on test No. 7. At 3 hours the iron was up to 1½ per cent.

Mr. Owen: That was atmospheric pressure? A. That was atmospheric pressure. And at 86 degrees—I calculated 85—and the acid was down under 14 per cent, 13.6. At the end of 6 hours the iron was up to 2 per cent and the acid was down to 12.5. And at 9 hours the iron was up to a little below 3, to about 2.8, and the acid was down to about 11½. And we will go over to the end point. At the end of 24 hours, both of them come together there at about 6½.

The Court: As you kept on across, the iron goes— A. (interposing): In time, yes, sir.

The Court: The iron would go up probably and then— A. (interposing): The acid would keep coming down.

The Court: The acid down? A. That is correct.

The Court: And it was just a coincidence that they met at the end of the day? A. That is true. You wouldn't know what was going to happen.

The Court: Somebody might get the notion that was a day's work, to bring them together.

Mr. Owen: Well, now, Doctor, look over your letter to me and be sure that you have stated in your testimony all of the points you wish to make of record? A. I should make clear one point which I have not, that this amount of acid that I put in the pipe, the 581 c.c. were calculated to fill a foot length of that pipe so that I had 8 inches of space, theoretically, above that. I can't say it was exactly a foot.

Mr. Lyon: The acid always stayed in that same foot? A. That is correct, yes, sir.

Mr. Lyon: It filled the bottom part of the pipe with acid? A. That is correct.

Mr. Lyon: And left it there for that twenty-four hours? A. That is correct.

Mr. Lyon: Or whatever period of time? A. That is right, sir.

The Court: It is just like a little tank half full? A. Yes. I was asked to make the test on the pipe and fix it up and run it under pressure, which I tried to do.

Mr. Owen: I find that I neglected to offer copies of the patents and publications which were referred to by Mr. Rebbeck, and I would like to supplement Plaintiff's Exhibit PX-338 by adding such references as were referred to by Mr. Rebbeck, but not included in that exhibit.

Mr. Lyon: In other words, you are going to add some more to that book, and they will be the ones that Mr. Rebbeck referred to, but which are not already in the book.

Mr. Owen: That is right.

Mr. Allen Owen: We are going to dispose of some of the matters that have been held in abeyance, without calling witnesses for them. First, we have corrected PX-232, having gone over it with Mr. Lyon, and that is a complementing sheet for PX-10, which shows the number of treatments performed by Dowell, Incorporated, and we have limited the treatments to exclude all of those which were made in California, because the California treatments did not involve the treatment of limestone formation. In addition, we have eliminated the so-called mud acid treatments, for much the same reason. We have eliminated the treatments of Dow Chemical Company, because they were not performed by Dowell. We have eliminated truck rentals, that is, instances in which Dowell did not perform the treatments themselves, but in which they rented their equipment for the performance of the treatment. We have eliminated these stuck drill pipe treatments, because that would not come under the Grebe and Sanford patent. We have also eliminated the packer seal treatments, which were of somewhat different type, and also scale removal treatments, and the elimination of the California treatments takes out most of the scale removal treatments. On checking back over the records for the past three years, Mr. Pennhaligan was able to find only six scale removal treatments which were performed in the year 1940, and he was unable to find the records, and, therefore, unable to estimate, as I understand it, the number of scale removal treatments performed during 1932 to 1937, in those intervening years. The number was quite small and would not substantially affect the total of the well treatments reported on this sheet.

Mr. Lyon: Will this have the same number, 232, corrected, Your Honor, or should it have another number?

The Court: You will call it 232 corrected, and I will give it number PX-347.

Mr. Allen Owen: In addition we had an exhibit which was formerly PX-233, which shows the number of treatments made by licensees of the Dow Chemical Company, other than Dowell. Now, we have corrected that report to eliminate the California licensees and thereby eliminate the treatments which related to stuck drill pipes, treatments of that character.

(Plaintiff's Exhibit 232 corrected was thereupon marked PX-347.)

(Plaintiff's Exhibit 233 corrected was thereupon marked PX-348.)

Mr. Allen Owen: This sheet shows during the years 1934 to 1940, inclusive, licensees other than Dowell performed 2,277 treatments. Then during the examination of Mr. Pennhaligan, Mr. Lyon requested a summary of the activities of the licensees of the Dow Chemical Company showing as well as we could the volume of the business which they have done under their licenses, and Mr. Pennhaligan has prepared a schedule which I shall request be marked PX-349.

(The schedule referred to was thereupon marked PX-349.)

Mr. Allen Owen: This shows that business, which doesn't reflect any income from the California licensees, but does show an income to the Dow Chemical Company, total income for 1936, '37, '38, '39 and '40 of $107,768.73 from its licensees.

Mr. Lyon: In connection with PX-349, we are to understand that any other licensees who were mentioned in Mr. Campbell's testimony, whose names do not show any payment on PX-349, haven't paid any royalties, is that right?

Mr. Allen Owen: I don't know exactly which licensees you refer to.

Mr. Lyon: I haven't had a chance to mention them, but if there are other licensees referred to in Mr. Campbell's testimony, whose names do not appear on this PX-349, why, you haven't received any royalties from these others?

Mr. Allen Owen: I don't think I can agree with that unless I am absolutely sure; I will find out and I will know this afternoon what the fact is on that.

Mr. Lyon: All right.

Mr. Allen Owen: Then in order to show the continuity of use of inhibiting agents and surface tension reducing agents in the activities of Dowell, Incorporated, Mr. Pennhaligan has prepared from the books of Dowell, Incorporated, a schedule showing the number of gallons of inhibited acid used by that company in all of its work, as well as the number of gallons of inhibitor which were shipped to the various Dowell stations, and the number of gallons of surface tension reducing agent which were shipped to various Dowell stations, tabulated by years. I would like that table to be marked PX-350.

(The table above referred to was thereupon marked Plaintiff's Exhibit No. 350.)

Mr. Allen Owen: That is a schedule showing the number of gallons of acid used by Dowell, and the number of gallons of inhibitor and surface tension reducing agent which were shipped to the field. This is the testimony that Mr. Pennhaligan would give were he recalled. He compiled these tables.

The Court: That does not include what that is?

Mr. Allen Owen: No, sir. I am looking for that data now. I intend to read that into the record next.

Mr. Wilber Owen: Another matter, counsel have agreed to clean up by stipulation, you will recall that we requested defendant to produce the acidizing order and data sheets for the some 100 odd well treatments made by the defendant in Michigan; the acidizing tickets for those treatments are in evidence, but in addition to the acidizing tickets in each case there is an acidizing order and data

sheet filled out, and that order and data sheet contains information regarding the well structure, that is, the depth of the formation and the length of the casing and tubing, and so forth, that is not contained on the acidizing tickets.

Now, in lieu of the presence of those acidizing orders and data sheets, for all of those 100 and some odd treatments, counsel have agreed that the data appearing on the acidizing orders and data sheets for the Stella Wilcox, the Zahn and Crawford and the Knight wells shall be taken as typical of the conditions which existed in the other—in connection with the other treatments, and I, therefore, offer as PX-351, a set of these four acidizing orders and data sheets, and also of the acidizing tickets, although this is a duplication so far as the acidizing tickets are concerned, of a previous exhibit, but I thought it would be better to have them in one exhibit, so I am offering those. They cover five treatments. Two Stella Wilcox treatments, Your Honor. And as long as they were all referred to in the testimony, I thought it would be better to include the order sheets and the acidizing tickets for each treatment, although it covers only four wells.

The Court: Acidizing orders and data sheets for four of defendant's wells, stipulated to be typical.

Mr. Owen: That is right, Your Honor.

The Court: That is all wells acidized in Michigan?

Mr. Owen: Well, it is all that were acidized in Michigan up to the time the depositions of Mr. Edwards, the Halliburton manager at Mount Pleasant, and some of the employees there were taken in June of 1939. And that, I understand, includes all of the treatments made up to that time, in the eastern district of Michigan. That is in this district only.

Mr. Allen Owen: To continue with my offers; the defendant wanted to know what inhibitors we had used commercially, and we have that information, and in some instances the material is named by the manufacturer, and therefore its exact composition is not known to us. This will be PX-352.

Mr. Lyon: These were those that were employed by Dowell before the filing of this counter-claim, is that correct?

Mr. Allen Owen: Oh, yes, both before and after.

Now, Your Honor has requested earlier information concerning the advertising by Dow and by Dowell Incorporated, and I have a schedule prepared by Mr. Pennhaligan from the books of the company, to which he would testify were he requested, which I shall request be marked PX-354.

(The schedule referred to was thereupon marked PX-354.)

Mr. Allen Owen: In connection with PX-350, we have prepared a chart showing the relationship between the gallons of inhibited acid, and the gallons of inhibitor, and the gallons of surface tension reducing agent, and have simply plotted these numbers on the chart in an effort to show that as one business—or as the volume of one item increases, so does the volume of the rest. I have reductions of that chart which I would like to have marked PX-350-A in order that it may go along with the table from which the chart is prepared.

(Photostatic reduction of the chart referred to was thereupon marked PX-350-A.)

The Court: Now, what about the men that are out, do you have solicitors soliciting business? Did they have during that period?

Mr. Allen Owen: If you will excuse me just a moment, I think I can get the answer to that question.

The Court: During these years we have the advertising expense.

Mr. Allen Owen (after conferring with Mr. Crawford): I am informed, Your Honor, that during the year 1932, there was no particular effort made to do anything more than to train men; and during the year 1933 very little salesmanship was employed, but most of the salesmen went around to service inquiries which came in, and it was not until 1934 that any active salesmanship was engaged in, because in that year competition appeared, and it became necessary then to sell the services of Dowell, Inc.

The Court: How many salesmen did they have in that year?

Mr. Allen Owen: We have a chart, Your Honor, which is in evidence, which shows the personnel and growth of Dowell, Incorporated.

The Court: Does that divide them into the different classes of employees?

Mr. Owen: No, it does not.

The Court: That is, as to how many were doing the work of acidizing, how many were in the offices, and as to how many were in the selling department?

Mr. Allen Owen: That is right it does not, Your Honor. I think the total personnel of Dowell, Inc., for the year 1933, for example, was 33 persons. There were six treating stations in operation. There were eleven pump trucks. There was one truck transport, and one tank trailer, or, three tank trailers, I beg your pardon. This appears on PX-94, and you will notice from that exhibit that the personnel—

The Court: What was it in 1934, the personnel?

Mr. Allen Owen: It grew to 60 that year. They opened four new treating stations, and bought five new trucks during that year, so that the growth in the field nearly doubled the number of wells treated in that year over the year before, and the personnel also was about doubled.

Mr. Wilber Owen: Counsel have agreed that in lieu of calling witnesses to show the brine well treatments made by the Dow during 1930 and 1931, somewhere along in there, that we may stipulate that if Ira Nolan Poffenberger were called as a witness he would testify the same as he did when his deposition was taken by defendant at Midland, at the hearing of July 24th to August 2nd, 1940.

The Court: That is relative to what?

Mr. Owen: Brine well treatments by Dow, and in Mr. Poffenberger's deposition he referred to a report he made to Dr. Grebe on September 26, 1930, regarding the acid treatment of well No. 77, and that report will be offered here as PX-362.

Mr. Owen: Mr. Penhaligen has prepared a statement of Dowell's advertising expenditures subsequent to 1934, which I offer in evidence as PX-360. This brings the advertising down through 1940, and at the same time shows the number of paid treatments using the Grebe and Sanford method. (Tr. p. 6663.)

IRA NOLAN POFFENBERGER

testified by deposition (offered by plaintiff) as follows:

DIRECT EXAMINATION

By Mr. Richmond:

I reside at 516 McDonald Street, Midland, and am a research chemist, chemical engineering, for The Dow Chemical Company.

I have a degree in chemical engineering from Case School of Applied Science, and a Ph.D. from Massachusetts Institute of Technology. My position with The Dow Chemical Company is research chemist in Mr. Putnam's department. That is the heavy organic department.

I am acquainted with John J. Grebe, and have known him since 1928. I first entered the employ of The Dow Chemical Company in 1928 as one of Mr. Grebe's assistants. I graduated as an engineer in 1928.

The first work I did in connection with the acidizing of brine wells was the latter part of 1929. The first well we used was an old well down behind our salt station, I believe well No. 3. Our first treatment was to run acid into the well through a short hose under gravity head from a wooden tank wagon—acid tank wagon. But the well wouldn't take a flow that way and so we used a little glass pump and pumped the acid from the wagon into the head of the well; at the same time we ran water along with it.

Mr. Richmond: How far did this hose extend into the well? To what depth, approximately? A. You mean—well, we used a pump. That didn't extend into the well at all.

Q. When you ran it under gravity. A. When we ran it under gravity it extended not more than 10 or 15 feet.

Q. Who was it that determined the apparatus and the method of treatment of this well No. 3? A. Grebe and I talked it over. He gave me free rein to do as I pleased, but everything I did was with his Okeh.

Q. Now, what strength of acid did you use? A. Oh, it was approximately 30%.

Q. And you put it directly into the top of the well and are you able to say what the degree of dilution was with the water introduced with it at the same time? A. I can't say it very accurately because the pump we used didn't work very satisfactorily.

Q. Then you aren't able to say what the acid was—whether it was a 10, 15, 5 or any other degree of strength? A. No. I am sure it wasn't over 15%.

Q. Now, what was the next well treated, Mr. Poffenberger, and when? A. It was around Christmas time. The next one, I believe, was No. 13, next to Grebe's house.

Q. What technique did you use on that well in treating it with acid? A. The same. We pumped into the head of the well.

Q. Along with water? A. Yes.

Q. You had one pump pumping water and the other pumping acid, is that correct? A. We used city water pressure for the water and the acid pump pumped only acid.

Q. And that pumped directly into the head of the well? A. Yes.

Q. Do you know a man by the name of Robert J. Quinlan? A. Yes, he worked for me.

Q. He worked along with you and did some of the manual work, is that correct? A. Yes, he didn't do much on that well I don't believe, but I am not sure. I don't believe he was working with us then.

Q. What other technique did you use in treating the brine wells with acid, mode of operation, method? A. You mean of any wells or just those two?

Q. No, any wells up to, we will say, 1930, '31, up to the time you quit treating brine wells with acid. A. Well, the first thing we did was to develop a pump that would pump acid for long periods of time without much attention. This was a two-cylinder pump with one piston. One piston was small and then it was in a large piston. The piston towards the stuffing box pumped water and the small piston

pumped acid. That protected our stuffing box so our pump worked satisfactorily. When we got that pump, we pumped all of our acid down through a hose that reached to the bottom of the well.

Q. And how long was this hose in most instances? Or how deep were the wells, we will put it that way, that you were treating? A. The deepest one was about 1400 feet.

Q. And you used a rubber hose 1400 feet long? A. Garden hose.

Q. How was that garden hose—was it strong enough to support itself? A. No.

Q. How did you support it? A. You can't get it long enough, either.

Q. Well, you can screw joints together, can you not? A. No, we used bakelite connectors that we stuck inside the hose and then put regular clamps on the outside, regular screw hose clamps on the outside that connected our links together. The hose itself was supported on a wire cable. The cable was run—we had a power winch that handled the cable and a reel that handled the hose, and we would start them both down together and at intervals of 10 to 15 feet we would spread the wires in the cable and use a copper wire to tie the hose to it, and then we would tape it.

Q. At intervals of 10 or 15 feet? A. 10 or 15 feet. That was about how close it was.

Q. How long did it take you to run this garden hose into a depth of say 1400 feet? A. It would take us two days.

Q. In making connections and all? A. Yes.

Q. And how long to remove this rubber hose from the well? A. Well, that wasn't nearly so long. Four hours.

Q. Now, did you use any other technique during the treatment of brine wells, either for increasing the flow of brine or for the purpose of disposal of brine in those wells? A. After we had that equipment, we used it on every well.

Q. And the technique that you have described is the only technique that you used in the treatment of brine wells

while the same were being treated by The Dow Chemical Company, is that correct? A. Except those first crude experiments that I have described. Those two techniques were the only ones employed.

Q. Do you know of anyone else doing work on brine wells for The Dow Chemical Company during the time that you have been with The Dow Chemical Company other than that work that you have described? A. No one did any acid treating other than me.

Q. Did you ever on these brine wells prior to February, 1932, use an inhibited hydrochloric acid in the treatment of brine wells, either for increasing the flow or for the purpose of disposing of spent brine? A. No.

Q. Did you do any work on inhibitors for hydrochloric acid during the year 1932? A. I wasn't here in '32. I left the Dow Company in September, 1931, to go to M. I. T.

Q. When did you return, Mr. Poffenberger? A. In 1934.

Q. Do you know when the last work was done in the treatment of brine wells by The Dow Chemical Company on any of their wells for any purpose? I mean by "treatment" treatment with acid. A. You mean the last work done up until the time I left, or since then?

Q. Up to the time you left in '32. A. '31. All that work was done by me. The last work was on wells 77 and 80.

Mr. Richmond: May we have the original records on 77 and 80.

Q. State if you know, whether there was any acid treatment of brine wells after you left in September, 1931? A. I can't answer that. I lost all contact with it.

Q. I will ask you this—at the time you left in September of 1931 were acid treatments of brine wells still continuing? A. No.

Q. And how long before you left in September of 1931 had the acid treatment of brine wells been discontinued by The Dow Chemical Company, approximately? I don't expect you to be able to say to the day or the week, or perhaps

the month, but approximately. A. Maybe I didn't answer that question before exactly right. Maybe Quinlan at the time I left still had some well work in progress. It is all close together in there and I just can't tell you.

Q. Well, when was the last work that you did on acidizing of brine wells before you left in September of 1931? A. You see you have me confused in dates. Maybe it's the year before.

Q. Well, I don't want to confuse you. A. If I remember correctly, wells 77 and 80 were treated in 1930 and that work was completed that winter. That was the fall I was guessing about Quinlan. The next summer we didn't do any acidizing work. We were working on brine disposal and we had drilled what we called our Parma well across the river for disposal of brine, and I was working there. So I believe that this acid brine treating had all been completed by the time I left in 1931.

Q. To your knowledge has there been any acid treatment of brine wells by The Dow Chemical Company since the last work which you mentioned in your last answer about wells 77 and 80? A. I believe not.

Q. Now, did you before you left The Dow Chemical Company in September of 1931, have anything to do with the treatment of any oil well with acid? A. No.

Q. In your duties with The Dow Chemical Company has the drilling, conditioning or maintenance of brine wells come under your department, under your supervision now? A. No, I have had nothing to do with wells since 1931.

CROSS EXAMINATION

By Mr. Owen:

Q. You stated that the first brine well you treated was the No. 3 well. Was that a producing well at the time you made these treatments? A. No, it was a discarded well.

Q. Do you know how long it had been discarded? A. I can't say exactly but I believe it was at least five years.

Q. What was the object sought in treating that well?

A. Our object in all of our first work was to dissolve out enough of a cavity so that a well could be used for the disposal of brine.

Q. Where did this brine come from that you wanted to dispose of? A. Waste brine from the plant.

Q. Do you have that waste brine in large quantities? A. Tremendous quantities.

Q. How was it disposed of prior to the time you began to treat these oil wells? A. For many years they put it into the river as they made it, as it was pumped through the plant. But it became a waterway nuisance so the question arose as to whether we could pump it back into the well or whether we would have to build these large impounding ponds. At that time those ponds were being built. This brine is stored—I believe it is stored sometimes as high as two years, until they have high water in the spring and then they put it in the river in regulated quantities.

Q. And is that the way the waste brine is disposed of now? A. Yes.

Q. Was the treatment of that No. 3 well successful in the disposal of waste brine? A. No, it wasn't very successful.

Q. Why not? A. That particular well didn't take brine very readily.

Q. What was the condition of the casing in that well? A. I believe that well had been plugged at the bottom but it had a hole in the casing.

Q. Do you know where that hole was located? A. I can't say now definitely. We had a means of determining it and I believe it was in the Parma formation.

Q. From what formation do you get the brine which is pumped for use in the Dow plant? A. I believe it is called the Marshall.

Q. Where is the Parma formation located with reference to the Marshall? A. It is above, at about 600 fee level here in Michigan.

Q. And the Marshall level is about what? A. Oh, 900 to 1200 in this region.

Q. I understood you to say some of these wells were 1400 feet deep. A. It goes deeper as one goes towards Mt. Pleasant. I believe 77 and 80 were 1400 feet.

Q. What is the character of that formation? That is, the Marshall formation. A. It is essentially sandstone.

Q. And what was the object of treating sandstone with hydrochloric acid? A. We hoped that there was enough limestone in it that when the limestone was dissolved out the sandstone would be made more porous.

Q. When you discontinued your work on the No. 3 well (that is, the first work) did you do any more work on that well towards the disposal of brine? A. No.

Q. Then you next tried the No. 13 well I believe you stated? A. Yes.

Q. Did you meet with any better success in that well than you did No. 3? A. The answer is the same—it wasn't successful. After we ran this well a short while it took tremendous quantities of water. We were connected with the city water line and it took tremendous quantities of water. At that time the well was standing with its pump rod in it. This well was a well whose derrick had burned down some time that fall. The well was abandoned by the Dow company.

Q. It had been abandoned before these treatments? A. Yes, the derrick had burned down and we used this old well for that purpose. When we found it was taking these large quantities of water, we felt there was a leak in the casing, not in one of the rock formations. Later we pulled the pump rods with a portable rig and dropped our conductivity electrode and found that there was a definite break in the casing of this well.

Q. How far above the bottom of the well, if you recall? A. I think, if I remember correctly, the break was around 300 feet, which is just about the bottom of the glacial rift on this elevation in this vicinity.

Q. And what did you conclude as to the point at which this large quantity of water which the well was taking was escaping from the well casing? A. It was escaping at this

higher level which was higher than we could allow for the disposal of brine.

Q. So that the acid was not reaching the Marshall formation which you wished to reach? A. No.

Q. Did you then discontinue your treatments of the No. 13 well? A. Yes.

Q. And did you thereafter treat any other wells for brine disposal? A. The only well that we treated for brine disposal and made a very thorough study of was No. 4, which was in the bromine plant out here. It was also an abandoned well. It had been closed at the top. It was under a concrete floor when we started the work. We broke the floor and put a new head on the well. The reason we picked this well, after we found out it would work, was mainly because it was accessible enough that we could pump brine to this well. We pumped brine into this well for a period of several months.

Q. Was it then abandoned for that purpose? A. Yes; it was abandoned when we obtained—it was just an experimental well and we abandoned it when we proved to our satisfaction brine could be disposed of down a well.

Q. You spoke of treating wells Nos. 77 and 80 for the purpose of attempting to increase the brine production from those wells? A. Yes.

Q. Did those treatments follow the brine disposal experiments which you have referred to? A. Yes, because we only had one winch and cable and hose setup.

Q. Were wells numbers 77 and 80 producing wells? A. Yes, they were very poor producers.

Q. Which of those wells did you treat first? A. No. 80.

Q. Can you state approximately the dilution of the hydrochloric acid which you used in the well No. 80? I mean the acid that was put into the well and down to the Marshall formation. A. The acid was taken to the well as 30% acid. It was put down with our two-compartment pump which pumped it down the hose at approximately 15% acid. We ran some brine back into the well, using the

pump pressure from other wells to do it, but what that quantity was I can't say definitely; the dilution of the acid at the limestone I couldn't say.

Q. How did the quantity of brine pumped into well No. 80 compare, roughly, with the quantity of 15% hydrochloric acid which you pumped into that well? A. Well, I can't answer that exactly. The answer to that is what I said before.

Q. Was well No. 80 drilled into the Marshall formation? A. Yes.

Q. And that was the same sandstone formation which you have previously referred to? A. Yes, so far as we know.

Q. Do you know of your own knowledge what effect the treatment of well 80 had on the brine production from that well? A. The well was originally what we call an 80-second well. It requires 80 seconds to fill the pail that they use in the wells. It is about a 3-gallon pail, roughly. After the treatment, the well became about a 60-second well, which is some improvement, but a good producing well in the Dow company's field runs around 20 seconds—20 to 30 seconds.

Q. Your treatments of well No. 77 followed that of well No. 80? A. Yes.

Q. And how did your treatments of well No. 77 compare with those of the No. 80 well? A. The results were similar. There was a slight improvement but not enough to make a good producing well out of it.

Mr. Richmond: At this time I ask that you produce the reports on wells 77 and 80.

Mr. Owen: We will produce those reports.

Mr. Richmond: I want to examine the witness on them. I want the original report.

Mr. Owen: Copies of these reports were furnished to defendant's counsel several days ago.

Mr. Richmond: I have received photostatic copies of problem No. 0109 together with the letter from Grebe to Griswold, dated June 6, 1932.

REDIRECT EXAMINATION

By Mr. Richmond:

Q. I show you Volume 8 of Physical Research Laboratory reports, and especially the problem No. 0109 by N. Poffenberger appearing in the upper right-hand corner of the first page. I call your attention to the three pages of the report accompanied by three pages of tabulation, and ask you if you made that report (handing same to witness). A. Yes.

Q. And that report was made to whom? A. To John Grebe.

(This report was offered as PX-362.)

Q. I call your attention to Volume 7 of Physical Research Laboratory reports and call your attention to file No. 0075, sometimes known as problem number, and particularly direct your attention to the two pages of the report made by you. That was made by you, was it? A. Yes, sir.

Q. On the date stated of 8-18-30? A. Yes, sir.

Q. And that report was on what well? A. 80.

Q. Brine well 80 of The Dow Chemical Company? A. Yes.

Q. I call your attention also to two additional pages one which has a curve, and the second additional page is a table. A. Yes.

(The report was offered as PX-363.)

Mr. Owen: Then it has been agreed that we may offer another report of Mr. Poffenberger's to Mr. Grebe, which was not referred to in the Poffenberger deposition, but which was referred to during other depositions taken at the same time. That report is dated 7/21/1930.

(The report referred to was thereupon marked PX-364.)

Mr. Owen: Now, PX-363 is short and I will read from it to give Your Honor an idea of the work. This report, I should have stated, related to acid treatment at well 80, the other report was at well 77. This states:

"**Results**:

"Acid and water or brine was pumped down the well to attack any limestone formation that might be present. Experiment was carried on from July 7th to Aug. 15. In the time 22,000 pounds of 30 per cent HCl solution was pumped down the well.

"At the start of the experiment the brine level in well was 108 feet from the top. At the end of the time it was 20 feet, the difference being due to the difference of the densities of brine and water.

"Water was pumped down well for one week during the time the rate fell from 0.4 gal. per minute to 0.1 gal. per minute.

"The rest of the time brine was used to keep the acid going down the well. The well took brine at a rate of 0.5 to 0.3 , al. per min.

"**Description of Work**:

"The brine level in well was measured by conductivity cell on end of wire and was 108 feet from top of well. This made a head of only 108 times 1 divided by 2.3 times 1.25 equalled 38 pounds pressure for putting down brine or 30 pounds pressure for putting down water. On August 16 when the work was stopped the level was 20 feet from the top, and on Aug. 15 it was 26 feet from the top."

The Court: All they put in that well was acid.

Mr. Owen: No inhibitor.

Mr. Lyon: And those were not oil wells. That work we contend had nothing whatever to do with the acidizing of oil wells, or the Grebe-Sanford patent in suit.

Mr. Owen: Of course our contention is, Your Honor, while it wasn't dealing with oil wells it did familiarize Grebe and Sanford—

Mr. Lyon (interrupting): Sanford wasn't mentioned. Sanford is dead now, and the testimony taken at Midland showed Mr. Sanford was in charge of this work.

The Court: That was a brine well?

Mr. Owen: Oh, yes.

Mr. Lyon: And there was no inhibitor used in that work at all.

The Court: What did that show? You have read it to me.

Mr. Owen: It showed they pumped, as I recall, 22,000 gallons of 30% acid—hydrochloric acid, into that well over a period of I think close to two weeks, quite a long period.

The Court: I remember it was a long period. I thought about that. I suppose they have been treating their wells over there with acid for a good while. I don't know.

Mr. Owen: Not for a good while. The testimony taken at Midland showed they started in 1929, continued through 1930 and up into '31.

The Court: There is nothing in the report about its eating their pipes and pumps?

Mr. Owen: I don't know whether in that treatment but in most of those treatments they put the acid down below the tubing by a rubber hose, using uninhibited acid.

The Court: Doesn't say that.

Mr. Lyon: It does in the deposition, Your Honor.

The Court: All right. Put it down by that old method.

Mr. Owen: This other report is by Poffenberger and Grebe.

The Court: Now I want to put that down. Put in raw HCl—

Mr. Lyon: With no inhibitor.

The Court: With no inhibitor.

Mr. Lyon: Through rubber hose into a brine well.

The Court: Through rubber hose into a brine well. But the same kind of rock. The fact it is a brine well—

Mr. Lyon (interposing): They weren't trying to increase the productivity of a formation in oil.

The Court: No, but they were trying to eat out the rock, weren't they?

Mr. Lyon: The deposition says they were trying to eat a big hole around at the bottom of the well so they could pump a lot of brine in there, trying to get rid of this brine.

Mr. Owen: I think that is not a correct statement of the deposition.

The Court: Well, any way, I don't see—they were putting it down into a well—

Mr. Lyon: To eat on the formation.

The Court: But they did use a rubber hose.

Mr. Lyon: And a pump.

The Court: There must be some iron in the pump.

Mr. Owen: I think they used a glass pump, Your Honor.

The Court: Does the deposition show that?

Mr. Lyon: I think it did.

Mr. Owen: One of the depositions did; whether it was Poffenberger's or not, I don't know. This other report is dated July 21, 1930, and states that the problem was received on October 31, 1929. It is entitled "Dissolving Scale in Tubes with Acid using some Arsenic Compounds to Prevent Corrosion of the Iron Tubes."

The Court: That is a report made at the time?

Mr. Lyon: That has nothing to do with wells, Your Honor. It is a problem in one of the shops where they had some scale on one of the tubes.

Mr. Owen: This is offered to show that when this oil well problem came up Grebe had this information regarding the efficiency of arsenic as an inhibitor.

The Court: Dissolving rock, you say?

Mr. Owen: No, dissolving scale.

Mr. Lyon: Boiler scale in tubes.

Mr. Wiles: That report says the scale couldn't be dissolved.

Mr. Owen: Let me read the report.

The Court: As to that, they were then doing what was very old?

Mr. Lyon: That is right.

Mr. Owen: Yes. It brings to Grebe specific knowledge of the efficiency of arsenic as an inhibitor. They weren't doing anything new.

Mr. Lyon: This wasn't part of Grebe's invention.

The Court: He is just making more prior art, if you want to put it that way.

Mr. Owen: The report reads:

"Samples of silicate scale were obtained from Nelson Griswold at the Power Plant. He claimed they were not affected by concentrated HCl and concentrated HNO_3, so no work was done on the scale.

"The use of arsenic compounds to inhibit hydrochloric acid corrosion was checked by laboratory corrosion tests, using acid up to 6 N." That is 20% HCl.

"Strips of sheet iron, about 6″ long and ¾″ wide, weighing about 10 grams were used in the work. They were placed in 500 c.c. of acid and allowed to stand 24 hours before they were removed, brushed and weighed.

"Sodium arsenate and sodium arsenite are both effective in retarding corrosive action of HCl at room temperatures. In general the arsenate is the more effective except at the highest concentration used—10 grams per 500 c.c. However they do not prevent corrosion.

"The table given below shows the effect of both change of acidity and changes in the amount of arsenic compound."

Then there are two tables: I think, Your Honor, you better read the tables.

Mr. Lyon: Tables are pretty hard to read.

Mr. Owen: Whichever you prefer.

The Court: Let's do both.

Mr. Owen: I will read it to you first.

The Court: No, I will look over your shoulder.

(Whereupon Mr. Owen read the following tables)—

"500 c.c. acid—2 grams of arsenic salt Normality 1"—I can't give you the percentages. Mr. Rebbeck can. What is 1 Normality HCl?

Mr. Rebbeck: It is about 3 or 4%.

Mr. Owen: That was 3 or 4% HCl with no arsenic. The per cent loss of weight was 6.7. Then it was tested with sodium arsenate at the rate of 2 grams per 500 c.c. of acid, and the per cent loss of weight dropped from 6.7 for the raw acid to 0.3 for the acid with the sodium arsenate.

A similar test was made with sodium arsenite. The loss there was a little less than with the arsenate—0.2.

The next one, with a normality of four—

Mr. Rebbeck: That is 15%.

The Court: I see the Gravell patent came out July 31, 1928. I was wondering if they were checking up on things they learned out of Gravell to see how they worked.

Mr. Lyon: It says: "Subject—Dissolving Scale in Tubes with Acid using some Arsenic Compounds to Prevent Corrosion of the Iron Tubes." That is some tube experiment. It has nothing to do with anything in an oil well.

Mr. Owen continued with the reading of the table:

Loss in Weight in 24 Hours Expressed as Percentages

500 c.c. acid—2 grams of arsenic salt

Normality	Per Cent Loss wt. of iron no arsenic	Per Cent with Sodium Arsenate	Per Cent with Sodium Arsenite
1 (About 3 or 4% HCl)	6.7	0.3	0.2
4 (About 15% HCl)	28.8	0.3	1.2
6 (About 22% HCl)	100.0	1.7	5.5

Loss in Weight in 24 Hours Expressed as Percentages

500 c.c. = 6 N. HCl—amount of salt varied

Grams Salt per 500 c. c.	Per Cent Loss wt. No Arsenic	Per Cent with Sodium Arsenate	Per Cent with Sodium Arsenite
0	100		
2		1.7	5.5
4		1.4	2.2
6		1.3	1.7
8		1.1	1.2
10		1.4	.7

The Court: Does this record show when Dow first used a steel tank to haul inhibited acid, or any other kind of acid?

Mr. Owen: I do not know that the record shows, but I think that it is safe to say that it was after they started acidizing oil wells. They used wooden tanks around the plant.

The Court: Out to their brine wells.

Mr. Owen: Well, around the plant, from one of their plants to another, to haul acid, they used wooden tanks.

The Court: I am wondering when they bought the first iron tank.

Mr. Owen: I don't know. I think that it may be assumed that it was some time after they began to acidize oil wells. Now, how soon after, I do not know.

The Court: What do they keep this acid in, hydrochloric acid, in their plant? What do they store it in now?

Mr. Rebbeck: My understanding is that they use wood storage or rubber-lined steel.

The Court: They still do that?

Mr. Rebbeck: Yes.

The Court: There wouldn't any of them but what in time, would eat up a tank, with any of your inhibitors, if you were going to try to have permanent storage.

Mr. Owen: I rather think so.

My next offer is four pages from the Journal of the Industrial and Engineering Chemistry, for February, 1912, an article relating to the award of the Perkins medal to Herman Frasch.

I offer this merely to confirm the statements that have been made here several times that Mr. Frasch was a very prominent chemist. This is offered as PX-365.

(A photostatic copy of the article above mentioned was marked PX-365.)

Now, the next offers I have are made in view of the fact that defendant offered a copy of the Carr patent, and the file history of the same patent, the Carr patent, 1,891,667, offered as DX-11, and the file history is DX-11½.

And, enough has been said to indicate that it will be defendant's contention that that application disclosed the process of the Grebe-Sanford patent. In order to meet that claim, it is our position, in the first place, that that patent, nor anything in the file history, even intimates that Mr. Carr was the inventor or claimed to be the inventor of the process of using inhibited acid. But, in order to cover the complete field, I have copies of abandoned applications filed about the same time as the Carr application, one of them by Richard H. Carr and Howard C. Humphrey, method for increasing fluid production from oil wells, and this is marked "Case 172." The file number is not given on this document, but correspondence from their patent attorney to which I will refer, fixes or identifies that date, or that number. That was filed on June 30, 1932, serial number 620,180.

The Court: Do you want that a separate exhibit?

Mr. Owen: Yes, I want that as an exhibit.

Mr. Lyon: I object to that, Your Honor, on the ground it is not admissible against this defendant on any theory of law at all, and, second, that it is not competent, no proof of the document at all. We are not stipulating to that document.

Mr. Owen: If the technical objection that it is not competent because it is an uncertified copy is urged, we

will ask the court for the privilege of ordering from the Patent Office a certified copy on order of the court. We cannot get it without order of the court.

Mr. Lyon: Why can't you get it?

Mr. Owen: It is an abandoned application.

Mr. Lyon: Well, there are plenty of contract relations on this acidizing subject between you and the Pure Oil Company; you have access to their applications, licenses under them, and all that. I don't see how other applications that the Pure Oil Company may have filed are evidence of anything against this defendant in this case.

Mr. Owen: Well, they certainly show what the Pure Oil Company was claiming at that time; they were concurrently filed with the Carr application which you have presented.

Mr. Lyon: We have already explained to the court we are not claiming that Mr. Thomas or anybody in the Pure Oil Company conceived of adding an inhibitor to the acid. They were the ones that went and suggested the acidizing of the wells, the oil wells.

Mr. Owen: If there will be no contention that the Pure Oil Company, or someone connected with the Pure Oil Company made the invention covered by the Grebe-Sanford patent, or suggested the invention, then I will not make these offers.

Mr. Lyon: I don't know what you are going to claim for the Grebe-Sanford patent, but I think I will make it very clear we are not asserting, or do not contend that Thomas, or anybody connected with the Pure Oil Company, was the one to suggest putting any inhibitor into the acid used in acidizing oil wells.

Mr. Owen: Well, that makes it unnecessary to offer these.

The Court: I will proceed; it is overruled, and let you admit it, and if later it seems important and there is a question about its admissibility, I will pass upon it with greater care, but I will let you admit it.

Mr. Owen: Then I will ask that this copy be marked Exhibit PX-366.

(The copy above referred to was thereupon marked PX-366.)

The Court: That is abandoned application for increasing fluid in oil wells, filed June 30, 1932, by Richard H. Carr and Howard C. Humphrey.

The Court: And assigned to Pure Oil?

Mr. Owen: It doesn't appear on this copy, but —

The Court: The reason I am trying to get the fact about that, from what defendant said they may save time if we have that in the record, if they want to raise any legal question about that.

Mr. Owen: We will offer a letter from Edward H. Lang, who was the patent attorney for the Pure Oil Company who handled these applications, to Mr. Thomas Griswold, Jr., of the Dow Chemical Company, who at that time was in charge of their patent department.

The Court: Of Pure Oil?

Mr. Owen: No, Mr. Griswold was of the Dow and Mr. Lang, who wrote the letter, was of the Pure Oil.

The Court: Wasn't this application owned by the Dow?

Mr. Owen: No, it was owned by the Pure Oil Company.

The Court: You admit it was owned by the Pure Oil Company?

Mr. Owen: Oh, yes.

The Court: And Pure Oil are a licensee of Dow, is that right?

Mr. Owen: Yes, and Dow is a licensee of the Pure Oil under these various applications.

The Court: Dow is a licensee?

Mr. Owen: Under all the Pure Oil applications and patents. Now, the next one is marked "Case 174," an application by Richard H. Carr and Howard C. Humphrey for a chemical reagent for use in oil wells, filed October 10, 1932, serial number 637,099.

The Court: Is that another abandoned application.

Mr. Owen: That is another abandoned application.

serial number 637,099, and it is noted right here that this was assigned to the Pure Oil Company.

Mr. Lyon: Same objection, Your Honor.

The Court: Same ruling.

(The application referred to was thereupon marked PX-367.)

Mr. Lyon: We don't know when these were abandoned; counsel says they were abandoned, I don't know what evidence there is that they were abandoned.

The Court: I don't know whether that makes them better or worse.

Mr. Lyon: I don't either; he says they are abandoned, but there is no evidence of it.

Mr. Owen: The next is another abandoned application. This will be PX-368.

(The document referred to was thereupon marked PX-368.)

The Court: The same parties?

Mr. Owen: Yes, Carr and Humphrey, the same parties. The title of the case is, "Method for Introducing Acid Reagents into Oil Wells by Gas Pressures." It was filed October 21, 1932, serial number 638,950.

The Court: This is the file wrapper in each one of these cases?

Mr. Owen: No. This is the application which was abandoned.

The Court: All right.

Mr. Owen: Then I also have copies of the two agreements between the Dow Chemical Company and the Pure Oil Company, the earliest one being dated January 31, 1933, which I will have marked PX-369.

(The agreement referred to was thereupon marked PX-369.)

Mr. Owen: And the later one, dated June 30, 1934, should be marked PX-370.

(The agreement referred to was thereupon marked PX-370.)

Mr. Lyon: The statement was made a few moments

ago, Your Honor, that Pure Oil Company had no conflicting claims to inhibitors. I call Your Honor's attention to PX-367, which is one of the alleged abandoned applications.

The Court: October 10, 1932.

Mr. Lyon: I am not going to read the whole application, but it starts out by saying:

(Reading): "This invention relates to an improved compound or chemical reagent for treating the producing formations of oil or gas wells to facilitate the flow of a desired fluid into the bore of such a well, and it is an outstanding object of the invention to provide an approved reagent which possesses the capability of reacting with such producing formations to partially dissolve or disintegrate the same or increase the porosity thereof, in order to render such formations around the well bore more permeable to the flow of the desired fluid into the bore, and thereby increase the fluid output of a well so treated."

Then it discusses the earlier application and says:

"We have found in the operation of our process that such an acid reagent while highly effective in increasing the porosity and fluid output of the producing formation, possesses the disadvantage of attacking the metallic members of an operating well, such as the ordinary tubing and casing, into which the reagent comes into contact, causing their premature impairment together with high replacement costs."

Then on the next page it says:

"We have discovered that improved resistance of the metal in the well bore to the corrosive effects of such reagent may be obtained through the use of a reagent modified in its action by the addition thereto of relatively small quantities of compounds belonging to the nitrogen groups, whereby the reagent may be passed harmlessly through metallic members or over metallic surfaces without exerting any material detrimental action thereon. In our aforesaid prior application, we have disclosed the use of an acid reagent consisting of hydrofluoric or hydrochloric acids, or a mixture of hydrochloric and nitric acids."

And, it mentions arsenic and in the first claim in the patent it calls for arsenic specifically, and in the sixth claim it calls for a whole group; it says:

"An acid reagent for treating the producing formations of oil or gas wells to increase fluid production therefrom, comprising a mixture consisting principally of a halogen-containing acid."

Which hydrochloric is one:

"—and a relatively small amount of a compound belonging to the nitrogen group."

The group of inhibitors that the patent specifies.

Mr. Owen: This application, Your Honor, was filed on October 10, 1932, after the Grebe-Sanford patent issued, and this is what the invention, alleged invention was: "In our prior copending application, serial No. 620,180, filed June 30, 1932"—that was the date of the Grebe-Sanford application also, you will recall—"we have set forth a process for accomplishing the above by the use of a reagent in the form of hydroflouric and other equivalent acid which is introduced into the well bore through the customary tubing or casing and advanced"—

The Court: This application, PX-367, was evidently prepared and filed for the purpose of getting into interference.

Mr. Owen: Oh, no.

The Court: It was after your patent had been issued; wasn't this after your patent had issued?

Mr. Allen Owen: Yes, Your Honor.

The Court: Well, they were seeking interference.

Mr. Allen Owen: They didn't copy the claims of the Grebe-Sanford patent, which they would have done had they been seeking an interference.

The Court: Maybe that is right, but they certainly would have got into interference with it.

Mr. Allen Owen: No.

Mr. Owen: No, the Grebe-Sanford patent is confined to the use of hydrochloric acid for acidizing limestone formations, and this is for hydrofluoric acid; that is an entirely different acid.

Mr. Lyon: That is just one of the acids, it mentions hydrochloric also.

Mr. Owen: It says:

"Hydrofluoric and other equivalent acid."

Now, we will go to the claims; that is the only acid specifically mentioned.

Mr. Babcock: No, hydrochloric is mentioned in there.

Mr. Lyon: No, it is mentioned in there.

Mr. Owen: All right, give me time. They go on to say:

"We have discovered that improved resistance of the metal in the well bore to the corrosive effects of such reagent may be obtained through the use of a reagent modified in its action by the addition thereto of relatively small quantities of compounds belonging to the nitrogen group, whereby the reagent may be passed harmlessly through metallic members or over metallic surfaces without exerting any material detrimental action thereon. In our aforesaid prior application, we have disclosed the use of an acid reagent consisting of hydrofluoric or hydrochloric acids, or a mixture of hydrochloric and nitric acids."

Now, that refers to the previous application.

The Court: That does refer to hydrochloric.

Mr. Owen: Yes. I want to read these claims, and then I will go to the previous application.

"An acid reagent for treating the producing formations of oil wells to increase fluid production composed of a mixture consisting principally of hydrofluoric acid and a relatively small quantity of an arsenic compound."

Now, they knew by this time that the hydrochloric acid that Dow was furnishing them for treating their wells contained arsenic as an inhibitor. Evidently Carr and Humphrey felt that they could accomplish something different, perhaps in different formations, by adding an inhibitor to hydrofluoric acid, and therefore they put in this application which didn't copy any claim of the Grebe-Sanford patent, and no claim in that application could have been placed in interference with the Grebe-Sanford patent.

The Court: Couldn't they make them copy their claims?

Mr. Owen: Yes.

The Court: I know they tell them to.

Mr. Owen: But they weren't claiming the same invention, you see.

The Court: You mean they are just claiming a different acid?

Mr. Owen: A different acid, yes.

The Court: Well, your patent would cover that.

Mr. Owen: No.

Mr. Lyon: What about claims 6 and 7, Mr. Owen?

The Court: Just a minute, please. All right.

Mr. Owen: I find I was mistaken, as I frequently am on documents I haven't read for several years.

The Court: That relieves me again.

Mr. Owen: There is a claim, there are two claims in this patent—

Mr. Lyon (interrupting): This isn't very important. We can't prove that these fellows made this invention. And in view of the tie-up of Dow and Pure we can't get them to give us any information to prove they made this invention.

Mr. Owen: What did your witness Thomas say? He was an honest witness. He said he made no claim to having made use of the inhibitor.

Mr. Lyon: Mr. Carr evidently claimed he wasn't. So we are wasting time.

Mr. Conner: Your Honor, there is no undue tieup between Dow and Pure, if I may state so.

The Court: There is an agreement.

Mr. Conner: A definite agreement.

The Court: You pay them a lot of money.

Mr. Conner: Undoubtedly we do.

The Court: And you did that to get rid of this danger that you had they were claiming invention.

Mr. Owen: Well, there is another element in these agreements that I haven't referred to which I should have referred to before. Both of these agreements provided that

Pure should purchase large quantities of hydrochloric acid from Dow. That was another consideration that passed to Dow. Paragraph 5 of the original, and I think the same is copied in the other agreement, states: "Dow hereby agrees to sell to Pure and Pure agrees to purchase and accept from Dow the merchandise herein described for a period of ten years from the date hereof."

The Court: I have so many lawsuits that are settled by exchange of licenses, I can visualize pretty well what happened in that. There was a contest on between Pure and Dow evidently as to who had the inhibitor right. And that is all either one of you had a claim for; neither of you claimed to have done anything different down in the ground, in the rock, except very remotely.

Mr. Owen: The Carr patent, Your Honor, which is specifically mentioned in these agreements is a patent for a process for treating a well which does not claim the acid feature at all. It is the process of carrying on the treatment by first filling the well tube with oil and forcing that oil up between the tubing and the casing, and then shutting off the top of the well head so that the space between the tubing and the casing is filled with oil while the acid is being forced down the well and into the formation. That is the Carr patent which does not claim anything about the use of inhibited acid. We got a license under that patent.

The Court: I haven't discovered anything new about what the acid does down in the wells since 1896, so far as what it does to the limestone. No witness has testified to anything new.

Mr. Owen: No. I don't think there is any different action, when it gets right down there.

The Court: So the argument between Dow and Pure must have been over inhibitors and not over what the hydrochloric acid or some other acid will do with limestone.

Mr. Owen: Well, I must disagree with Your Honor, because there was no controversy between Dow and Pure as to who invented inhibitor or first used inhibited acid for acidizing an oil well. There was a misunderstanding as to

what each party was claiming, and I think they thought they were overlapping in their claims, but when they came to find out what each party was claiming, there was no overlapping, and each only got what he was entitled to.

The Court: What did they have that Dow wanted? What did Pure have that Dow wanted?

Mr. Owen: They had this Carr contract, or this Carr patent I have just told you about, which is used in treating wells and they had four or five other pending applications.

The Court: What does the Carr patent do?

Mr. Owen: That is the one I just told you about, that covered a process of filling the well tubing with oil, and forcing the oil up between the tubing and the casing, and then closing it off at the casing head, so that when the acid is forced down into the well it cannot get up between the tubing and the casing. But there was no controversy between them as to who was the inventor of using inhibited acid for acidizing oil wells, and Mr. Thomas very frankly stated he made no claim to any such a subject. That is all the evidence we have, Your Honor.

The Court: I don't see what difference that makes, anyway, in a case in which I haven't any proof that they were the first.

Mr. Owen: I don't think that it makes a particle of difference. It was dragged in by Mr. Lyon in their defense, and I thought it was up to me to show the whole picture, and I don't think it has any bearing on the issue here.

The Court: I don't see that it does.

The court stated that all exhibits which had been offered during the course of the trial would be considered as having been received in evidence.

PROCEEDINGS ON SETTLEMENT OF FINDINGS OF FACT

Mr. Owen proposed the following finding: "It is of great importance to increase the ultimate total production of the well by making it possible for the ground pressure to force a large proportion of the total oil into the hole. It is the accepted belief among oil geologists that the methods of operating prevailing before 1932 left about 2/3 of the oil in the ground."

Mr. Lyon: I should think that word "left" in the next to the last line there, it would be safer to say "may leave" because I don't think this court should be put in the position of finding as an absolute fact that the oil geologists have an accepted belief. We only have one witness, and if we could leave a little latitude it wouldn't hurt the finding for Mr. Owen's purpose. You might say "may leave about 2/3 of the oil in the ground." That is a speculative proposition.

Mr. Conner: It is the belief of all petroleum geologists that a very high percentage of the oil in the ground was left there, even after the well had finished its economic production.

Mr. Lyon: That may be true, and I imagine there is a great deal left after you get through acidizing. But, to find as an absolute fact it is an accepted belief that there is two-thirds of it left, it seems to me, is going too far. I think that the finding should allow some latitude.

The Court: I like it this way better: It is estimated by oil geologists. Something like that.

Mr. Lyon: I think that is better.

Mr. Owen: All right. Methods of producing, then.

Mr. Lyon: The methods of production. All right. That is all right. Then "The methods of production" instead of "operating." The "operating" means how they operate their pumps and their machinery.

The Court: The whole lawsuit was tried before, and

this time, to make it appear that the discovery of this acid that doesn't eat the pipe has cleaned out the ground with all this oil. Now, I haven't that notion at all, and I want to emphasize it on here. I haven't a bit that notion, that it is all due to this, because the acid with the inhibitor in it that goes into the rock doesn't eat the rock any different at all than it ever did, and if they had figured some way to shorten up their seal, there might have been some trouble and done something, but when they got around to do it in that way, they would never have let all that oil stay down in the ground just because they did have the oil. I am going to have much to say about that before I am through, but I want you both to know now that that is my idea, so I won't be making inconsistent findings of fact.

There is one right there. The very first sentence in the opinion out there, I assume it changes a little bit later on—I am not taking the time to look that up, but the first thing said by Judge McDermott—I would like to find that here—

"The object of the invention is to increase the recovery of oil from wells in a limestone formation," and so on.

Now, that isn't the object of this invention. The object of this invention is to prevent acid from eating iron. That is the object of this invention, and to say the other is just as ridiculous, and any written opinion I write now must not put a word in that is critical of anybody else, because people ought to be tolerant and I don't like that sort of thing in people, and I don't mean that sort of thing, but I only mean to emphasize my views about this patent, and I might just as well begin to do it here.

That is not the object of this, any more than to say the object of it is to increase bank accounts. You can keep on going back and back with your objects, but it just shows, and it results from notions like you got in this finding right here for me to sign that breaches that thing.

Later on it does find that about the iron in this opinion, but right at the outset you can see how Judge McDermott, the way this case was tried before and the way it has been

tried this time, keeps you looking down in the ground at that acid eating the rock.

Well, there isn't any invention about that at all. In this case it doesn't eat the rock any different than it did in 1896, when that fellow invented the patent to eat the rock. It doesn't eat it any different, and any judge that thinks about this case ought to have that in mind, that the acid with the inhibitor in it that goes out into the rock and does its job there, isn't eating it any different, isn't going to get any more of the oil out.

And, here is a patent that I am hearing, and that the Tenth Circuit heard, and is aimed at preventing acid from eating iron, and that was to be put into this case early and hammered in, because it has got started and I can see the purpose of it.

The patentee, when it started, thought they had a patent for eating rock, and they had to back up and get all you can get through the Patent Office, and they have kept that in all the way through right up to now, and it is right in this claim, and I don't think that. I don't believe that. I am not going to find that at all. I am going to find it just the other way.

This is a patent to prevent acid eating iron, and we will have to talk about that later, but that is all it is. It is not a patent that does any different down in there at all, and it won't get any more out of the earth than it would if you did not have the inhibitor in. Not one bit.

Now, in all of these findings I am going to watch for that, because you can see that when a patent that is of the kind that isn't on anything that it does in the rock at all, and the judge who has reversed the case and written opinions—but, the way the case is tried, and the record, and the emphasis it puts on it, it starts out by saying: "The object of the invention is to increase the recovery of oil from wells in a limestone formation and is obtained by injecting an inhibitor," and so on.

He does say later on: "The genius of the invention is in the use of the reagent," and all that, but that isn't—that

is on the facts now that we are finding here. I want to be careful about the findings that I make here, so that they will disclose my views about these things.

Now, I don't think that the percentage that they get now and the percentage that they got before this has an awful lot to do with it, because it doesn't eat into the rock any more or any better, nor gets that off any better. It is only a problem of getting it down in there. In this case you can read the record. You read the testimony in this case. The testimony is all pretty near about how much more oil they got out of a well when they acidize it than they do if they don't acidize it, when the test of the profit would be how much less iron did it eat with the inhibitor in than it ate with the inhibitor not in. There is the test. That is what this patent aims at, and it has just got started talking about the other thing, and this decision is going to be on the other basis and on the other theory. I do not see it at all. I don't believe that other theory at all, and I cannot go along with it at all, and I thought when we got there I might better let you know.

Mr. Owen: Of course, by not answering Your Honor's remarks at this time, I do not want to be taken as agreeing with them.

The Court: I know you don't. We talked about this all the way through. There is no use to wait any longer to tell you what I think about it—"increase the ultimate total production of the well"—I am going to cut that last sentence out. I am not going to find that, I just refuse that last sentence in its entirety. It shows it is testimony. All of these other things they do, make the acid go in easy, they all help some. Your blankets, that had some, I don't know, there are so many things that have been done, that it is just another thing steering on the wrong track to find that it makes any difference in this case. How much on the total, because of lack of knowledge about a thousand different things. If I had only the patent for getting the acid back out of the well, put this finding in, and the court didn't study the record carefully, might reach the conclusion,

"Well, it is all due to that patent," then to find out how much they were getting out before Chamberlain pulled his acid back out of the well, why, give it all to that one. We have a lot of things can happen all the way down through, and I don't think that is helpful. I think it is misleading.

Mr. Owen: "As early as 1895, Frasch and VanDyke, working jointly, undertook to overcome the inherent difficulties above outlined by forcing concentrated acid, preferably hydrochloric, into the pay around the well to enlarge the openings, remove accumulated obstructions, if present, and free up the flow. Frasch, at the time, was one of the greatest and best known industrial chemists. He originated the methods of sulphur mining still in use for the production of most of our sulphur, and he developed the refining methods which made the oil from the Lima, Ohio, field usable. He was later given the Perkins medal, the highest honor obtainable by an American chemist."

The Court: Who introduced him and gave it to him? I ought to put that in there, oughtn't I? I don't want it, but that sounds like a cum laude decoration. It is decoration day for graduates.

Mr. Owen: Well, the article is in evidence, Your Honor?

The Court: I know it. There are a lot of things in evidence. I will have this just a mile long. I can make a long speech about all the fine witnesses in here, where they got their degrees and how much, but I don't intend to do it. I don't know. Well, let's see, maybe it is agreed to. Many of these things, they aren't harmful.

Here is VanDyke. It sounds like the way the Republicans put a man in nomination for office.

Mr. Owen: Shall I continue?

The Court: Yes.

Mr. Owen: "VanDyke was a prominent member of the old 'Standard Oil Group' in Cleveland, was later head of the Atlantic Refining Company, the Standard Oil subsidiary in Pennsylvania, after the dissolution of the old Standard Oil Company in 1911 continued at the head of

this company, and was a little later also the head of Atlantic Producing subsidiary."

The Court: I won't give it even if you both agree to it. That is just too ridiculous for a finding of fact, most of that. It is just a laudatory speech. I never heard of such a finding of fact by a judge. Just a laudatory speech.

Mr. Owen: No. It just tells what his connections are.

The Court: What a great man he is. What has that got to do with it?

Mr. Owen: The purpose of it is this, Your Honor. Perhaps you don't appreciate what we have it here for, but the purpose of it is to show that the men who controlled the Frasch patent were in a position to introduce and extensively use that invention throughout the lime fields in the country. We show by testimony taken here in the form of stipulations some of the leading men in the Atlantic Producing Company, they testified to these—

The Court (interposing): That is what you get by that sort of testimony. Judge McDermott thought the Mellon Institute had found it so difficult that they recommended something that wouldn't work at all, when, on the rehearing, it disclosed that that wasn't the situation at all. That is the danger with this sort of argument and theory.

Mr. Owen: Here is a prior art patent, the Frasch patent that is being relied on very strongly to show there was no invention in the Grebe-Sanford process, and the proofs show that the Frasch process was used for a period of a few months down in Ohio and then it disappeared. Now, I think it is very pertinent to show that the men who controlled that Frasch process were in a position to have given it extensive use had it been a practical process.

The Court: Yes. And you want to argue that that is the reason it failed, because this ate the iron, and I can think of more reasons that it might have failed from. That is just one. There isn't a word in the record to show that is the reason it failed, and that is the reason they gave them up any more than you did over here in Midland. There is a good deal more reason that Dow was notifying their

customers that they were infringing than because their acid was eating their pipe a little.

Now, the acid was eating the limestone, and I am going to keep talking about that all the way through in this record so that when this case gets to the Court of Appeals they are at least going to know that I have got the notion that what this patent is about, all there is to the claim is that they have got an invention that it wouldn't eat the iron. That is all it is about. There has been some argument here that this patent works different, because it doesn't eat up too much of the acid, that the acid is stronger when it gets down there. Now, that is all just argument. The patent wasn't granted on that. There has been argument here, it is suggested and it was argued in the other court that "Well, they didn't know how acid with an inhibitor in was going to act in eating the limestone."

Now, that was in the other case and it was tried to be injected into this case. It isn't in this case, there isn't anything to show that anybody ever thought that inhibited acid would act different way down in the bowels of the earth than it did above, and that that held this back. There isn't anything of that kind in this case, and I want to emphasize it so there will be no question about it, that that is what I think about it.

So, it is easy to go wrong in a thousand places in this case. Now, that is absolutely wrong reasoning. There isn't anything in this case that justifies the argument that the scientists and the operators and the practical men were being held back just because they didn't know—they knew about inhibited acid, but they were afraid if they put inhibited acid in it wouldn't act down in the bowels of the earth and eat the rock as good as it was if it wasn't in. Well, there isn't anything to make anyone think that. That is just argument without justification for it.

Mr. Owen: I am sorry to disagree with what Your Honor states.

The Court: I know you do, and the whole case has been tried on the other theory, but I don't agree with it, and I want it known I don't agree with it at all.

Mr. Owen: No, we haven't advanced that theory as a basis for the standing of this Grebe-Sanford patent. I think I should tell you right now what our theory is, if it isn't clear. We claim that by the Grebe-Sanford process we do two things, we protect the pipe and make it unnecessary to use special pipe or dump bailers, or anything of that kind to get the acid down into the well, and that because of the fact that it has been protected against eating the pipe you have a stronger acid to do the work that it is intended to do when it gets there.

Now, Your Honor says that is an afterthought. I want to tell you that is not an afterthought. It is in the record, it is in the Grebe-Sanford file history. During one of the arguments—may I read this—

The Court: I say that sort of a theory is just as far away as it would be if you invented a tank to haul to a well to put it in and because your tank prevented slopping and losing some of it on the way to the well you tried to hitch it up with the acid eating the rock when it got into the well and say, "I have got a new invention, I don't slop out so much, and I am going to use that down in the well, and therefore when it gets down and eats the rock," and so on and so on; I say that you would have to measure that; you couldn't measure that by saying how much more rock I could eat and how much more oil I could get, therefore how much good I could do by my invention that would prevent the tank slopping acid out. I say you have got to stand on your tank and the amount of acid you lose and the value of the acid, and that thing, and so down here you cannot carry that on. What difference does it make except for your loss in your acid? It doesn't eat any different down in the well and it doesn't consume the rock any different, and the amount of acid you lose is like the amount of iron you lose.

You just get credit for that, if your patent is good, and good as the first to use inhibitor. But you ought to measure it by the value of the acid and by the damage to the tubing, or the lack of damage to the tubing, and not go

on down into the well and talk about how much formation could be eaten out, and then how much oil could be obtained, and then how much money could be gotten for the oil.

Mr. Owen: Well, I think we are entitled to measure it by the results we have obtained.

The Court: Well, I say you are entitled to measure the results obtained by that little additional acid that you save, by its not being used up eating the pipe, and the same as if you had a patent on the tank that—transportation tank that prevented some slopping over. You wouldn't think of going on down where your destination was and saying how much work would that 50 cents worth of acid have produced, and earn me a lot of money when you got there, but you would measure it by the value of the acid you lost. Now, that is logic, and the other is just misleading somebody and trying to get to a wrong decision, and that is in the other case and I am determined to keep it out of this case, so that—

Mr. Owen (interposing): Well, I can't agree with that view of the invention at all, Your Honor.

The Court: No, I know you can't.

Mr. Owen: Well, we have here two patents, both aimed at doing the same thing. One of them the Frasch patent and the other the Grebe-Sanford patent. One of them, the earlier one, went about it in an impractical way which never made any impression on the art. Now, we come along after there has been a crying need for a practical way to carry out that process for 40 years, we come along and in a simple way we show that that process can be carried out, and, in carrying out the process in our way, we do three things.

In the first place, we protect the tubing and, therefore, we make it unnecessary to carry around a special tubing or dump buckets.

In the second place, we carry the acid into the formation in substantially the full strength in which we deliver it into the pipe.

The Court: There is nothing in your patent about that.

Mr. Owen: I want to read it. It is in the file history.

And, in the third place, this patent points out something that is really important, which has not been emphasized, but it is really important in carrying out this process, and it is the thing that all of the licensees and all of the infringers do, and that is instead of using 30 or 40 per cent strength hydrochloric acid as Frasch proposed to do, we propose to use from 5 to 20 per cent hydrochloric acid, with a preference for 15 per cent, and the 15 per cent acid is what has been used generally by plaintiff, its licensees and infringers.

Now, Your Honor, if you remember that curve of the corrosiveness of hydrochloric acid, it starts in down in the lower left-hand corner with a very low rate of corrosion at 5 per cent. At 10 per cent it is a little higher, and at 15 per cent it is still higher, but still way below the corrosiveness of the acid which Frasch proposed to use. Your Honor remembers that curve.

Now, we did those three things, and as a result of those three things we have made practical and successful a process which broadly was suggested by Frasch 40 years ago.

Now, I don't see how these inventors, who have made that practical, can be thrown out of the window on the statement that all they did was to show how to protect the iron. They did more than that. They made this thing successful where it was a failure before.

The Court: It doesn't do one whit different after it leaves the pipe than it did before.

Mr. Owen: When you get it down there, I admit that is true. Coming back to the proposed finding, Your Honor, I say that it is pertinent to show that the failure of the Frasch process was not due to any inability of the owners of that process to put it over if it was successful, and if it was practical; and I think that these findings regarding Frasch and VanDyke are pertinent to these issues.

The Court: You mean as to their standing? Well, now, we go back down in Ohio where they used it, and I suppose if they were dumb, I don't know, would it be all

right for the other side to show what a dumb lot of fellows they were that were using it down there?

Mr. Owen: Maybe they were dumb, but I don't think so.

The Court: But, I say, I don't think it is material. How about the first part of that? Mr. Lyon, I haven't heard from you. I am going to strike out all this laudatory talk about those gentlemen.

Mr. Owen: I don't care about the laudatory talk. I wanted to get in this record here that these men were in a position to get that process over, had it been a practical one.

The Court: What about the first sentence there?

Mr. Lyon: I think they are spending most of their time on the laudatory work, and they are not completing the finding.

The Court: I will deny this one as it is there.

Mr. Owen: In its entirety?

The Court: Yes. I can't take the time to modify them so much like I did yesterday afternoon. I just spent all the afternoon taking requests which were wrong, and trying to make them good.

Mr. Owen: I don't want to be persistent, Your Honor, but it does seem to me that as to VanDyke—let us cut out Frasch, whether he got a medal or not—but as to VanDyke, the half owner of the patent, I think it pertinent to show that he was a prominent oil man at the head of a large oil industry which owned and controlled large lime fields and was in a position to put that process into operation had it been a commercially practical one.

The Court: Then I would want to go in and know how much attention they paid to it. I have known men to be directors of banks and not go to directors' meetings more than twice a year, and have a lot of money invested in the same bank. This whole thing has been, as I see it, built upon that sort of straw man. I call that a straw man.

Mr. Owen: You have got to account in some way for the fact that that Frasch process was tried out in a half

dozen or more wells over a period of three or four months and then dropped, disappeared.

The Court: I can think of a lot of reasons, many things dropped. Why was this dropped over here in Midland when those men started to put down their acid?

Mr. Owen: Because it did so much damage to the well.

The Court: I don't think so. I think it stopped because Dow sent so many notices to their customers and they only had $400.00, was it, capital stock.

Mr. Owen: No. They kept right on. The fact is that during the time they were getting the damage they were not infringing the Grebe-Sanford patent, but they didn't stop when they got the notice. Instead of stopping they adopted the Grebe-Sanford process and began to use inhibited acid, and continued to use it for two years, nearly.

The Court: I can think of so many reasons why things start and stop. Suppose they got one of those wells down like that mine they sued that went to the Court of Appeals and was affirmed, and the plaintiff got $8,000, because they didn't put a blanket in the well. They don't have any blankets this deep. Suppose they had to put it down in these wells and got brine. "Bing," it would have been said that is an awful thing and would have killed it for the next ten years. I don't know whether or not it would have been for 20 years, if that was in the first one. Supposing that happened to be the first well, it wasn't at all, but so many things put things out of business that it is unfair, and this record has been, as I see it, and the other case, those things were emphasized, the only reason in the world the judge held your patent good, that is all he had, he says in substance that is all on account of your wonderful success, and he turns around and gives you all this, and I can not find in the record you ever showed you followed your own patent down there on that record. Maybe you did, but it is a pretty weak showing, if it can be dug out of there, that you followed your own patent.

Mr. Owen: Mr. Dougherty of the Oil Makers was on the witness stand and he told Your Honor why they went

out of business, it wasn't because of the notice of infringement at all, because they continued to infringe for a number of months after that.

The Court: They were operating on a shoestring.

Mr. Owen: The reason they went out of business was they were operating down in Louisiana and out in Texas and the price of oil went down to 10 cents a barrel and they had contracts, their pay was partially in oil, and they couldn't make good continuing through.

Mr. Owen: "19. Prior to the date of the application for the patent in suit, the Gypsy Oil Company had a problem in the Glenpool Field in Oklahoma, caused by formation of 'Gyp' scale on the casing, tubing, working barrel and pump rods of an oil well, which formation interfered with pumping of the well and necessitated frequent shut-downs and loss of time for removing rods, valves, etc., and cleaning off the scale. A suitable scale solvent was sought which could be used in the wells to remove scale and thereby to avoid frequent 'pulling' jobs. The problem was submitted to the Mellon Institute at Pittsburgh, the result of steps made at the Institute being contained in a report by Dr. Westcott. The report, while not made public recommended the use of hydrochloric acid as the scale solvent, and the addition of Rodine, an inhibitor, to the acid, to prevent its attack upon the metal parts of the well. The report also suggested that the use of the acid in the well might also remove Gyp from the face of the sand and thereby increase production."

The Court: Well, that sounds all right.

Mr. Lyon: Well, Your Honor please, its is evidentiary, I think, and the way I have it is in my proposed finding, 33:

"Such an inhibitor was added to hydrochloric acid by the Gypsy Oil Company in 1928 for the purpose of reducing the corrosive action of acid upon the well pipe and equipment in the well when introducing the acid into a well to remove calcareous scale and deposits therefrom."

That is the ultimate finding as to what resulted from it. I say in 34:

"Such use of hydrochloric acid containing corrosion in-

hibitor was reduced to successful commercial practice by the Gypsy Oil Company in 1928, and was not a mere abandoned experiment."

I think Your Honor is entirely familiar with the fact an abandoned experiment is something that was not completed. It doesn't—if you do the job once, and successfully do it, it is not an abandoned experiment at all.

The Court But is that inconsistent with this?

Mr. Lyon: No, it isn't inconsistent with it.

The Court: In any respect?

Mr. Lyon: I think this could be adopted.

The Court: That sounded all true to me. It is open to the objection that I am telling what is in a report, but it seems to fit in with what has gone before, and I say as to what criticism I have offered about requests to charge. I recognize how difficult they are to draw and how you can't draw a nice dividing line, only my thought was the others were just top-heavy on that side, but this would cross the line, but it wouldn't seem objectionable to me to state what is in that report. It fits in with the other. And I say it is one of those places where the twilight zone is bigger than the rest of it. I will give that one. It sounds to me like the fact about it, and you are getting over into a place, that, I think, is very material. What was done.

Now, the ignorance of someone, of some folks, I don't attach very much importance to. What they don't know. You take for instance the gentleman from the Bureau in Washington. I do not consider it of very much importance what he doesn't know. I don't consider it of very much importance what the Bureau doesn't know, in deciding a case.

The prior art is made up of things that people do know, and what individuals do not know. Now, that is the prior art, through publications, through patents, and through reducing to practice other things, in those three ways, that the world does know, and this country knows, about reducing to practice what they do know, and that isn't affected by what people don't know. I think there is a

thing that hasn't been recognized in this. It is running through here to show what people don't know.

Now, he may be a most excellent lawyer, and there are plenty of things in the law that he doesn't know. Now, it would have no importance to call him and show what he didn't know, and I don't in these patent cases—we could make a record without end if we were going to show when we came to the prior art what people didn't know. Now, what we do show properly in the prior art is what was known, and that again is emphasized by the fact that we see plenty of people travel the same road in inventions. You can find it here, things that are known to the publications somewhere, to the patents somewhere, or to reducing to practice somewhere, but here comes along an individual as wise as they are, but he doesn't happen to know it, and he does all the work and uses all the actual ingenuity of the orininal inventor, and yet he can be rewarded because he isn't rewarded for what he didn't know or what anybody else didn't know. He is only rewarded for being the first. We have to keep that in mind in these patents, prior art. 19 is given.

Mr. Owen: 20 relates to this Gypsy Oil Company alleged prior use. "The engineers of the Gypsy Oil Company advised against pouring any large quantity of acid containing the inhibitor into a well and suggested methods other than the one recommended in the Wescott report whereby the acid might be employed for removing gyp from the well tubing, casing, and pump parts, and even from the face of the sand without permitting introduction of the acid into the producing formation, and recommended that some such method be tried as an experiment. The evidence is not complete as to how the experiment was conducted, but Dr. Knappen, testifying, and the Gypsy Oil Company engineers, whose reports on the experiment appear in the Gypsy Oil Company executive file agree that production of the wells was not increased."

The Court: Denied, for several reasons; one is that it is just telling what somebody has testified to, and if the

Court wants to know that, let them read the record. It is not for me to summarize, reduce to narrative form the testimony of witnesses, and, in the next place, this is a side thing, this is the one—is this the part where they let it run in gradually?

Mr. Owen: Yes.

The Court: What has that got to do with the cause of the—after the Mellon Institute made a recommendation of something and they do it and it works just the way they recommended it exactly, now, somebody out there tries out another thing and didn't succeed. I don't see what that has got to do with it. Why show a failure in something on some other side line? That is misinterpreting of the prior art again to show how little somebody knows. We are concerned with what they did know and what they did do, not how little somebody knew, whoever he is. I deny that one for two reasons.

Mr. Owen: I would like to present another finding on this Gypsy Oil matter which I will have to prepare. I think it ought to be in.

The Court: Maybe you can bring it up in connection with their requests, Mr. Owen, and I will give it careful consideration then, because I know they have got one that isn't passed on. I have heard it. It sounded about right to me.

Mr. Owen: "21. Subsequent to November 12, 1928, and at various times during 1929, 1930 and 1931, a number of further tests"—well, that relates to the same thing.

The Court: Yes. I deny that. They were trying to treat their pipe, as I understand it. If they wanted to, why not plate it the way this man Frasch, the old 1896'er suggested?

Mr. Owen: No.

The Court: Is that the one where they were putting it in gradual, a little bit at a time, letting it trickle down?

Mr. Owen: Yes. They weren't trying to plate the pipe. They were trying to prevent the formation of the scale on the pipe instead of removing it after it had been formed as by the Dr. Wescott—

The Court (interposing): I would call that an unsuccessful and abandoned experiment to something that didn't affect the prior art. That doesn't lessen it. It doesn't show that the thing Mellon had suggested was impractical. It doesn't show that. It doesn't show that the thing that is now being done was difficult. It just doesn't have any bearing on the thing. Chaps out there, after they had performed this successful experiment, and got their results the way Mellon recommended, they had a thought and they tried it out, and it didn't work. That is all there is to that, and I don't think it should affect this lawsuit at all.

Mr. Owen: Well, it seems to me that it has some bearing in this connection, that the last time they tried the Wescott suggestion was on the William Barryhill Well No. 8, March 18, 1931. Then there was nothing more done with that treatment, so far as this record shows, I think there was nothing ever done.

Mr. Conner: Maybe Your Honor doesn't have in mind that there is a distinction between gyp removal and the treatment of the formation.

The Court: I do have the difference, but what difference does it make between the time you stopped and you started with it?

Mr. Conner: Well, I tell you the way I see that gyp evidence was in the last suit, the defendant was maintaining that this practice of Gypsy was a prior use of the Grebe-Sanford patent.

The Court: I know. But, Judge McDermott evidently thinks there is something wrong with that. He thinks that was an unsuccessful thing out there.

Mr. Wiles: Well, it was.

Mr. Conner: It certainly was.

The Court: You do it the same way, and it is successful. Why?

Mr. Conner: I don't know why we have made it successful, but we sure did.

The Court: I know why. You have got a big fine outfit, but that doesn't make a patent.

Mr. Conner: Are you trying to tell us that the Gulf Oil Corporation is smaller than the—

The Court (interposing): No. But, they aren't good oil treaters like you are. They hire you to do it, don't they?

Mr. Conner: The Gulf Oil Corporation, Your Honor, I think without controversy spends the most money and has the largest laboratory and does the most research of any oil company.

The Court: You treat their wells for them.

Mr. Conner: They were trying to treat them then.

The Court: Who does treat them now?

Mr. Conner: We treat some, and I think Halliburton does some.

The Court: Don't you see you are arguing to me because they didn't do it, the reason they didn't do it is because they didn't know enough. They are not doing it. It is because you have got a good outfit, just like I hire a sheep shearer, because he is a good shearer. I know how to do it, but I am not a good sheep shearer, and I am busy with other things, and I hire him to do it. He has a little outfit down there.

Mr. Owen: When they started to use Dowell treatments, we did not have a good outfit.

The Court: Well, you figure out some way that will explain why treating gyp failed back in 1929 and why it succeeded in 1932, and thereafter, and you did it in exactly the same way.

Mr. Wiles: We didn't do it in 1932 Much later than that.

The Court: There is a long interim in there, in gyp treating.

Mr. Conner: I don't know whether we are talking about the same thing at all. Gyp treatment is an entirely different thing from acidizing wells.

The Court: I know it is.

The Court: Well, here is the finding I am willing to make: "During this time, prior thereto, and subsequent thereto, wells were treated with acid without inhibitor."

Mr. Owen: That is right.

The Court: That is as far as I can go, if that is of any help to anybody.

Mr. Owen: This 24 will read: "After September 11, 1929, the next Gypsy Oil Company well to be treated with inhibited hydrochloric acid was the Lovett No. 1 well, producing from a limestone formation in the Ritz Pool, Kansas, which was treated with inhibited hydrochloric acid by Dowell, Incorporated on February 10, 1933, for the purpose of increasing the oil production from the well."

Mr. Lyon: I object to the statement in regard to the next well for the reasons we have already discussed. And I think this finding should just say that the Lovett well No. 1, Lovett No. 1 Well, of the Gypsy Oil Company producing from a limestone formation in the Ritz Pool, Kansas, was treated with inhibited acid by Dowell, for the purpose of increasing. That is the finding.

The Court: I am inclined to think in view of what Judge McDermott has said which, of course, our Sixth Circuit will read, that it might be helpful to them, and it is the only reason I think I want to reverse what I have just said. I have just indicated I don't think that Gypsy Oil treatment with the inhibitor in where they tried to dribble it down the well, and they had some theory that didn't work and didn't arrive anywhere, that doesn't have anything to do with the case. But a person that doesn't have the time to read our entire record, but reads Judge McDermott's opinion is going to be in doubt about that, and I am not sure but I think, I am glad to hear what you gentlemen say, that it might be well to say on that exact date, from so and so to so and so, the Gypsy Oil Company tried an entirely different experiment than the one suggested by the Mellon Company and went on their own initiative and tell briefly what it was, and that it didn't succeed. And then if you want to write in the next one, I don't see any relation between the two. It was true they used inhibitor, and then jump right over and say that on such a date this company treated it. Now, does the record show clearly to me what happened in between?

Mr. Lyon: Nothing, it doesn't show anything about what happened between the date of that dribble treatment and the date of this first well.

The Court: They might have made a different dribble treatment, for all I know.

Mr. Lyon: They might have done a lot of things.

The Court: I haven't any showing about it, and I didn't listen carefully or ask questions for the purpose of finding out what happened in between.

Mr. Owen: The correspondence which is in evidence and which was also in evidence in the Williams case shows that after trying the dribble treatment for the removal of gyp, some of the engineers, or Gypsy men, recommended that they try some other scale remover, commercial scale remover, and they bought some of it and tried it on one well, and then a little later they tried to remove scale by mechanical means, by putting something down the well, some mechanical tools to knock it loose. So the record does show they did that.

The Court: I say there is something they did in between. Now, if I am going into that, it seems to me—I don't always do—if Judge McDermott didn't have that in his opinion about that two years, and didn't attach importance to it, I wouldn't feel that it was necessary for me to make any reference to it, but he does, and he has, and I don't think it is important at all. You can see not only for the other reasons, when I don't know why a thing stops, I don't see how I can attribute it to some particular thing, but more than that here is a thing that did succeed and some years later Dow successfully does the same thing, namely, removing gyp in identically the same way, no different at all except that they are a better organized, better equipped business way of doing it, instead of puttering around the way men would do out in an oil field in doing a job of that kind. Now, that is the only reason I can see why one succeeded and the other failed, because so far as removing the gyp is concerned, they are done exactly alike.

Now, if that story is to be told, I think it ought to be

put in—in that way, and I am of the opinion that in view of Judge McDermott's opinion, it better go in here and go in just right, put it all in there, not as to what they have testified to, but I am willing—I believe that testimony—I am willing to find that that experiment was conducted out there, and that it wasn't successful, it wasn't according to the Mellon proposition, and that the first one was successful that followed the Mellon proposition, and these other things they did, so it shows what was happening, and then the date, if you want it, that the first treatment was made of a well for them with the acid—that isn't the same kind, now.

Mr. Lyon: No.

The Court: That is one of the misfortunes that Judge McDermott was hitching—and so far as defendants are arguing, and I will say something about that later, because there is a good deal of force in that argument, that because they were putting this very inhibited acid down in there for taking the gyp off, you are getting pretty close to what the patent in suit attempts to do, I am telling you; there isn't much space left in there, we are near putting it down in there to take off gyp, but I see for the purpose of meeting that, you have got your argument that there is a difference. But I don't see then but what it ought to be known that that very gyping and their methods recommended by Mellon and followed by the gyp, is the very method followed by Dow. I think that ought to appear in here.

Mr. Owen: Well, we don't know that, Your Honor.

The Court: You don't know what?

Mr. Owen: I don't know that it is the exact method, so far as I know, both of them put inhibited acid down that well.

The Court: Of course, they did it better, and that is the reason. But so long as you are talking about failure and why they failed, there is something that is worth our thinking about, when there is a thing that goes to sleep, and the Dow revives it and does the same way and gets good results and makes a success out of it, and makes money out of that thing, while they come around with it and make

three successful efforts, but they don't care to go ahead with it.

Mr. Owen: I think we could prepare a finding along that line and I will discuss it with Mr. Lyon.

The Court: All right.

Mr. Lyon: If we cannot get together, why, we will bring it back to the court.

The Court: Well, when I was saying they were successful and when you are saying they were successful, we were both meaning for the purpose that the Mellon Institute recommended them, and for the purpose they made the experiment. They were only working to do something about that. But they went further and said, and they had a pretty good thought, that maybe, if you followed that old patent of 1896, why, maybe you will clean up the well, too, and get more production by this experiment with gyp, which was successful, which was the one that the Mellon outfit had recommended, which was for removing gyp.

Mr. Lyon: And at page 18 of his deposition, Dr. Knappen testifies the treatment of the Berryhill No. 8 was a complete success from the standpoint of well trouble.

The Court: Yes. You take it that it was unsuccessful as to removing gyp?

Mr. Owen: No.

The Court: I don't know as to the failure after that. I think Judge McDermott got the idea there was, but I can see how easy it is to get the wrong idea in the trial of this lawsuit.

Mr. Owen: Mr. Wiles reminds me that there was one of those reports which stated that the Westcott treatments were technically successful but commercially unsuccessful. That was the statement.

The Court: They had to rig the whole thing up for the first one they made, and put all their expenses in, and I will guarantee the Dow showing would be equivalent, if you charge in all of the expenses and trouble you went to to make your first step, then you would be money out all right.

Mr. Owen: That is right.

The Court: I would call that successful, now, in my honest opinion about it. The Mellon Institute was proven exactly right.

Mr. Schaffer: What disturbed me, Your Honor, is the impression I received from one of your remarks that you thought that this patent should only be tested by the inhibiting art, and not by the well acidizing art at all.

The Court: One ought not to forget that the way this acid works down in there is no different than it was before, and that all you are entitled to, and all you have accomplished, and all you claim you did, is the saving in expense and you just make it top-heavy with the argument about how much oil you make on the theory that this stopped, because it was no hot and destroyed so much pipe, that that is the reason it stopped. There is not any evidence in the record, in my judgment, that shows that as the reason. And, the whole case has been tried on that theory, and argued on that theory, and evidently everybody except the district judge out there proceeded on that theory.

Mr. Schaffer: If we were the ones to make it work successfully, aren't we entitled to that boast or that claim?

The Court: I don't know when I ever had a patent where they just jump right over the thing that was new, claimed to be new, and leave it so completely alone. You find it in pretty scattered places in this record. The new thing you did was to, according to your own claims, that was old for metal generally, according to your own claim the thing you stopped was eating metal. Now, if that did so much harm that it ruined everything, why, all right.

Mr. Schaffer: Can't we go a step farther than that?

The Court: I don't think there is anything in here that shows it is so dreadful a thing. I say it is a good thing. There isn't any doubt about it. But, to say that without it, it is so bad that a good organization like Dow, without the other, mind you, if it wasn't in existence they wouldn't be using it, I think it is a great presumption and no more true than to say they wouldn't be taking gyp off now if you hadn't made the invention which you admit doesn't have

anything to do with taking gyp off, your invention doesn't. That was old. And, yet, undoubtedly many times more wells have the gyp taken off now than did before.

Mr. Schaffer: We claim, Your Honor, that that is a point that goes our way rather than against us, because it shows how close they got to the acidizing step and still did not realize it. May I proceed, Your Honor?

The Court: Yes. And, before you do, to save your time and to start Mr. Lyon and his side thinking about it, I haven't, while I came up here last night and worked until nearly ten o'clock, I spent my time reading patents, and I haven't read the record, if it has been transcribed. I presume it has. But, I haven't read it.

I don't think the question of aggregation is involved in a chemical process. I discussed it in showing how I looked at the genius of the invention, and how I pulled it apart and tried to put it together, and talking about it as you would if it had been a machine, talking about an aggregation; but, as a matter of law and a matter of fact, I think a chemical process always must be tested on the old inventive theory as to whether or not there is ingenuity enough to give it a patent or not, and whether it is old, whether the method or process, whichever you want to call it, is old or new, and if enough new so that it required genius to make it, I don't think we do—I talked very much here about buzz-saws, and corn shellers, and things that you would make, and a hot candle. That is my way of thinking about this, only reaching the amount and degree and kind of invention that it required to make this process or method, and I am not of the opinion, and I think the record disclosed that, that I intend to dispose of this case, this patent; on whether the method and process is new and enough new to reward it with a patent or not. And, I don't expect to approach it, and I think I have said that, only we were talking about the other, I think I said and I intended to say, and I now say, that I don't think when you are talking about something made with chemical elements or a process for using it, and a method for using it, that you apply this principle of aggregation. It just doesn't fit.—

And, all I meant by the numerous illustrations and visits we had was to try and test out how much of novelty there was, if any, and if there was some, how much effort it took to develop them.

Maybe Mr. Lyon differs with that theory, but I don't think there is any question of aggregation. I notice now that my friend, my distinguished friend, Judge McDermott, gives a portion to that and discusses it, but I imagine he thought of it and he seemed to have discussed that phase of it much as I was discussing it, only reaching the opposite conclusion about it, I don't think he thought that aggregation applied to this kind of a patent, even though he gave that sort of a heading to it, and I don't think,—I don't know of any case that says a chemical patent for a process or for a method is bad because it is an aggregation of something. When you go to thinking only about aggregation, I just can't apply it to a chemical patent, and I don't think any court ever has.

Mr. Lyon: I haven't asked for any findings, I haven't requested any findings on the aggregation feature because I think that is too debatable. I can conceive that there might be a case where chemical things might not be truly related and be claimed when they are nothing more than an aggregation, but I haven't proposed any in this case. I have treated my findings, as Your Honor will see, on the question of invention, testing it in the orthodox fashion and not asking the court to rule that this is an unpatentable thing because it is a technical aggregation.

The Court: Then I don't need to spend any time on that. We are down to the one thing, the thing we are to decide is simple to get at but not so simple and easy to decide, but it is a question of whether or not there was invention in this method described.

Mr. Schaffer: Well, Your Honor, I think that it probably would be well for me to defer the more detailed discussion of the authorities that I have in mind. I think there is one question, and it can be briefly discussed, that we would like to bring more clearly to Your Honor's attention

at the present time, and that is the bearing that such findings as long-felt want and success might have or would have on the case as we view it.

The Court: When you talk about a wonderful growth of a thing you have got to do some studying to know why, and a good share of what you have got is because I kept talking about that, and there is a lot more I should have talked about.

Mr. Wiles: Perhaps so.

The Court: To see how that thing did go, and just why. And I have never known of a case that leans so heavily just on that one thing myself as right here.

Mr. Wiles: I didn't think, Judge, that you had ever—most judges never do have a case that falls into this narrow groove.

The Court: I very seldom have one that don't urge it. They urged it,—

Mr. Lyon: In the Balloon Tire case.

The Court: Yes, the Balloon Tire case; they urged it in this Ventilator case not very long ago, the Chrysler I refer to, that was their big thing there, how it had grown, but I looked through to see why it had grown, and in these days of big business there is a very different situation than when we had a lot of little fellows scattered around. This thing you have been talking about has been getting more dangerous for judges to be influenced by, unless they are very careful and if you will notice in this record, I began very early to suggest that thought that I wanted something to know why it grew, because I early reached the conclusion that you now say is right, that that was the thing you were relying on.

Mr. Wiles: Wholly.

The Court: And I have been saying that is the thing that Judge McDermott put it on, and I thought you were disputing me on it, but now I wish I could have known at the beginning of this case that you conceded that that was what—without it your decision would have been the other way.

Mr. Wiles: Oh, certainly.

The Court: In the Tenth Circuit, and without it the decision should have been this way. I would have been thinking and rivetting my attention to that, and thinking of more things I had been asking for to have you produce information than a little. But, my attention has been scattered, and I think you will see the record is, relative to this patent, to a very wide range of things.

Mr. Owen: This point hasn't been discussed at all, and I would like to just mention it, that no matter how narrow Your Honor may consider the Grebe step to have been, and if you confine it to the placing of the inhibitor in the acid, why, then, with that construction of the claims we get a rather narrow protection at the present time, because it does appear that due to modern equipment, high powered pumps, and enabling the introduction of the acid into the well quickly, that it is not necessary to inhibit it as highly as it was with the old equipment, and it may be that in open formations they can get by without any inhibitor at all.

All we are asking in this case is that the defendant use what they claim is being used by the Chemical Process Company, and if they will do that we are perfectly content to let them go on their way and compete with them just as much as we can, but we do say we are entitled to what little protection, what little benefit may be derived from the use of the inhibitor.

The Court: Of course what I want to do is to find your facts without reference to the law, without reference to where it leads, but as you can see my notion seems so in conflict with your views, and really to be fair about it, so contrary to the views of the Court of Appeals, results from my thinking differently about the facts than you do and the Court of Appeals, very largely, now.

I think Judge McDermott applied the right test in that case, as near as you can get at it. He didn't say some things that looked to me as if he was—I don't reach the conclusion that he didn't consider at all the difference and put it between your patent and the Frasch patent. It is plain that

he did, and he reached the conclusion there was enough, but he did make great use of—almost seemed—the development in the art, the success, and I don't want to be understood as criticizing Judge McDermott. I do reach a different conclusion as to the facts. When he says the gyp was a failure, I don't think it was. When he says the Frasch patent, when they applied it, that it was a failure, and his testimony wasn't so complete probably as mine, I reach a different conclusion so my findings of fact now are necessarily going to be different.

You see, if I am going to follow Judge McDermott's opinion, all I have got to do is to follow it. And the result is clean for me. That was the easy way out for me, and I wish it could have. That would make such an easy thing for me to do. I get back to this thing: Frasch was not attaching big importance now to how to get it down. He is just going far enough to show you what he could do, as he looked at it. He did not even bother to claim it, and I agree to all you said about claiming and all that, but it just goes to show that Frasch was not greatly concerned, he isn't claiming he discovered anything new about how you put it down or anything of that kind.

He is looking at his discovery, to the big thing he did, and the only big thing he did was to discover that that acid would eat away the rock and that you could press it back by pressure, and it is when it had eaten the rock, it was in solution, and you could fetch it out. That is the big thing that Frasch did. And he did not attach enough importance to those other things, so he thought he could get any patent on them, and I doubt, he probably could have put it in the process, but I don't think you could have added much, as I look at it. I think that is one thing to bear in mind on this whole case, that he did not consider that of a mighty lot of importance. If he had, he would have tried to make a claim that would cover it in some way. Isn't that logical?

I am going to say before I am through with this case I don't think there is any difference from an inventive standpoint between Frasch and Grebe and Sanford, except the

inhibitor. Now, that is my honest opinion and I am going to say that and stand back of that, and it would be perfectly right for anybody in the world to disagree with me, but that is what I think and that is what I am going to say.

Mr. Wiles: I shouldn't object at all, when you say "from an inventive standpoint."

The Court: I said that over and over, but I think it is idle for me to tell the Court of Appeals what Grebe and Sanford said, they had better read it and find out than for me to try to tell them my opinion. I am saying right now, if you prepare an opinion for me, to put in that I don't think there is any difference between the two, and I am talking now not about the color of the print they used when they printed it, or whether it was coarse type or fine type, I am talking about the standpoint of invention, that I cannot find one single thing in Grebe and Sanford that I don't find in Frasch, except your inhibitor. Now, that is my opinion and I want to say that, and I am not going to say any different than that. That is what I think and what I want to say. Now, I don't care whether it is, and I think it is more properly the way I am saying it now, in the way of a conclusion of law, I think maybe that comes closer to a conclusion of law, but I do think it is wrong for me to take these patents and go through them and make a finding of fact as to what they mean. That goes for the exhibits and it goes back to what I was saying before. I don't think it is my premise.

Mr. Owen: Then I suggest, Your Honor, that no finding be made for either party as to what the Frasch patent shows.

The Court: All right, but that is a conclusion of law, and I have already stated it on the record, so you have got that in.

Mr. Owen: (Reading): 26:

"Prior to 1932, there was no teaching that an oil well producing from a limestone formation could be treated with hydrochloric acid to which had been added an agent to reduce the corrosion of the metal equipment of the well by acid."

Mr. Lyon: Outside of the Frasch disclosure, a general statement that other methods of protection could be used—we don't claim that anybody had actually used an inhibitor in treating limestone. The Gypsy came pretty close to it. I mean limestone formation, when they used an inhibitor in treating limestone scale to protect the pipe upon which they passed the acid. But, I think this finding is worded to catch a reader who is not on his guard, I can see that, and yet I don't claim that there was any use of an inhibitor other than what I have stated.

Mr. Owen: Well, this states very clearly the fact.

Mr. Lyon: I am not sure how clear it is.

The Court: How about the teaching. Is it an unsuccessful experiment so far as it took that gyp out of the well down in there, but somebody may say that that thought—it seems to me it would teach anybody, if it had been limestone formation they could have used it. But I don't claim, it is an experiment, and I don't think teachings undisclosed are evidence against you. It isn't a public document. It was a private document, as I remember. Isn't that right?

Mr. Owen: That is right, Your Honor.

The Court: But I think you could draw the conclusion that—I will deny that.

Mr. Owen: Well, I don't like to argue a point after Your Honor has reached a conclusion, but it does seem to me that this is rather important for the plaintiff.

Mr. Lyon: Why isn't the next finding just as good, Mr. Owen, if we can agree on it. If we can—if we can okay that one, why isn't that one just as good for your purpose?

Mr. Owen: They are two differert things.

Mr. Lyon: I thought they were pretty much the same.

Mr. Owen: No, the first one, 26, is directed to the teachings of the prior art, and there was no teaching of the prior art that this process could be carried on. The only teaching—the only thing that might possibly be a teaching was what was in the paper.

The Court: If somebody taught it and hadn't put it into practice, you could say it wasn't any good. Now, why

have me say something th did not do, that isn't material. I am not sure whether th aches—it sounds pretty near as if whatever they said gyp, telling if they got any gyp down in the rock, w was sand and was not lime, that they could probably eat it off with this. Well, if it had been lime, they pretty near tell them they could eat it off, but because they taught them that, it did not teach them in a publication. And did not reduce it to practice. They can't use it against you here. But there it is for me to negative the fact that it taught—

Mr. Lyon: (Interposing): It certainly taught one important element, and that is that you could put an inhibitor in an acid and protect the pipe while the acid was going down the pipe. It certainly taught that.

Mr. Owen: But it certainly did not teach the engineers and officers of the Gypsy Oil Company that they could—

Mr. Lyon: How do we know?

Mr. Owen: Because they didn't do it.

The Court: That is, the word "learn" goes in there instead of the word "teaching."

Mr. Owen: Well, I read Your Honor here a few days ago a letter that the officers—to the officers—or the production manager, it was, of Gypsy Oil Company, wrote to Dow when we started in acidizing wells, and they were anxious to know when we could acidize a well for them out in Kansas, and that letter was written in January. That letter was written in January—where is that—1933, and the first well that was acidized for the Gypsy Oil Company was in February, 1933, by us, as a result of that letter.

Now, in 1928, Westcott made his report to the Gypsy Oil Company, and they treated two or three wells according to his recommendation, and that did not teach any of the officers or production men of the Gypsy Oil Company that they could do that same thing in limestone.

The Court: I am going to let that stand denied. I don't think I need to make a finding of that kind, about what was taught.

Mr. Owen: Then the next one: "The plaintiff, in 1932,

was the first to treat the producing formation of a limestone well with inhibited hydrochloric acid charged into the well through the pump tube."

The Court: Given.

The Court: If he had my case right here, I think Judge McDermott would have reached a different conclusion on validity. In fairness to Judge McDermott, he has intimated as strongly as I ever heard a judge that it was right on the bare point just in his re-hearing, and he again emphasizes that, and I am convinced that if he had this record I have, with all these different things that have been brought into it, that weren't there, more thoroughly and more completely, I think he wouldn't have thought, if he had this record here, I don't think he would think that the gyp was a failure for gyp, and I don't think he would think that those experiments down in Ohio were failures, and I don't think he would think that the Mellon Institute recommended something. Of course, he did have that before him on the re-hearing.

Mr. Owen: He corrected that and he did not have before him any evidence that this Frasch patent ever went into use. So that he made no mistake on that.

The Court: That isn't very important, but that is what I think about it just the same. And our own good court and three judges instead of one are going to be able to talk that over and think about it, and they aren't going to follow me about that, but I am giving them the benefit of my opinion about that, and I think it is fair to Judge McDermott too for me to be able to say that, when I reach a different conclusion than he did. It goes way beyond my taking his record.

I will say in addition to that, I am equally frank to say on this record that I think on his record I would have decided as I here decide, but I think there is a decided difference in the two, more complete, and in a close case, as he recognized it was by expressive statements, why, I think it is enough to have tipped it the other way. So I will let that stand.

I don't think it is a finding of fact. I don't state that. But it is true. I don't think that is a finding of fact. It is more a finding of how my mind worked, and it is measuring up to voluminous records, so I don't want our Court of Appeals to be—and they will, they will know what I am doing, that there is a long record over there, that I haven't read all of it, but as this testimony came in I looked back there and I have learned in different ways as to what was there, and what was here, at different times, so I have had a chance to get into that and I think I ought to express myself. I don't consider it as a finding of fact, though, by any means a very proper finding of fact, but I am willing to express myself on the subject.

I am of the opinion that oil wells can be acidized successfully without an inhibitor. You take this off the market. It has been sort of a thing now that doesn't do the least bit of harm, and you put it in because it doesn't do any harm, but I think it has been over-emphasized in this case all the way through, the impossibility of doing that without the inhibitor. It is far from being impossible to do it, and if there was some way you could think of taking the inhibitor off and going ahead and acidizing wells this business would not stop.

Now, that is another test in connection with what it has done to it. I am just as convinced as I can be if you take the inhibitor off they wouldn't stop acidizing wells. It would go right on today in my judgment now.

Mr. Wiles: Judge, I wonder if I might ask a question. We have, as I understand it, conclusions of law to draw, and that will, to some extent, take the place of a formal opinion. As I understand, Grebe and Sanford, you say, is bad for want of invention, and that is the ground of invalidity. That is the acidizing process.

The Court: That is right.

Mr. Wiles: The same is true of Gravell; Gravell is bad for want of invention.

The Court: Yes. I haven't put it just in this way because we have been talking about separate patents, but

to my mind, that first one, Gravell, and Grebe-Sanford in a similar class in this respect,—there are many other things to be said, but I think of, first, somebody is thinking of an inhibitor, and they began by making inhibitors, and, oh, there are so many inhibitors. There is the metallic inhibitors, and there is the organic inhibitors, and there is the combination of them, and, oh, so many different combinations that could be made for an inhibitor, that it is almost a problem for a great mathematician to tell how many combinations you could work out.

It did grow, that inhibitor business, it grew and they improved it as they thought of new things, and they got to simmering down to the best of them, and the best combinations, and all those things, and it is hitched in there in a way with the plating art, kind of grows out of that because, I believe, my final conclusion out of inhibiting, is that it does put a film on the thing that it is going to protect similar to plating, only the film that gets on there isn't permanent, and we don't think of it as that in the regular, —what we have come to call the inhibitor.

It is a flopping or looser, less permanent sort of a thing, but its method of getting there is very similar to that, and the plating art was very helpful, if you can call them separate arts, the plating art and the inhibiting art, they are right in the same field, they are dealing with the same sort of things and the same sort of principles and the electrical part of it is so similar. They run along together, and as the years pass that is getting better known until when it got down to the time of Gravell you had to do something pretty outstanding, in my judgment, in order to get a good patent, something outstanding with all the things that had been taught. If you want to do some particular thing, and you want to put it on fast or slow or permanent or temporary, or store it here and have it stay for a longer time, or for a short time—there are so many combinations and so many uses, and yet the general story about inhibitors was mighty well known when it came to the day of Gravell.

And, while maybe you can find some new combination

growing out of it, the main thing he was thinking about was using this old principle of an inhibitor in a particular spot, namely, when you stored it in iron drums or containers.

Now, I think that the art had advanced too far, and that the inhibitor was too well known for him to get a good patent on that particular use of it. Of course if he had started way back in the early days and had discovered an inhibitor, and had not gone as broad as he wanted to, limited himself to drums and containers, we would have protected him in what he claimed out of the larger field that he might have, but I think he lived too late and worked too late and invented too late and got his patent too late to be allowed a patent because he thought of drums and containers.

I think it got to such a state that wherever you wanted to inhibit iron, whether you were working in the factory or out in the field or this state or that state, or even in one art or another art, that it wasn't invention in my judgment to apply that to steel drums and containers.

You see, I am leaving out of that thought now the new combination that he claims to have got, putting arsenic into the acid regulator, or what could be called an organic base.

I know that the claim is there, but I say I think that they made so many different combinations that it is just going to be too bad for business. I think of an invention, that we ought to treat in the courts these patents in such a way that it can carry out the real purpose of the patent law, which was that it should help business and help the world by bringing them something new that is going to be useful, and we are going to award the individual that produces that sort of thing by a monopoly for seventeen years, and then when the people are going to get the advantage of that thing for the world thereafter. That is just a bargain you make with him, and we ought to look to a patent and see whether or not it is working that out and accomplishing that.

Now, I think Gravell's patent would work just the op-

posite way. I think that somebody some day, when they really badly wanted a container and they found the iron was eating up, they would say, "Well, we will put in one of these inhibitors," which was always in existence; that is what I think would happen, and I don't think you can reward him with that patent, and if you did see the misfortune it is going to be to business.

It prevents the world from using the invention of the inhibitor so that it will not eat iron and steel.

Instead of it accomplishing the thing I think that the patent is for, I think it would work just the other way for that patent to be good.

Now, we come right along a few years and we run right into Grebe and Sanford. Now, we have got this old inhibitor thoroughly investigated made new by Gravell, but many others, it is well known about the inhibitor, but it will stop anywhere in the world so far as I know, I don't think there is a time when you take hydrochloric acid and you put these inhibitors in that it don't help and check the eating of that iron. Of course it isn't as specific, it doesn't do it a hundred per cent, but it checks it and that was well known and everybody knows that.

Now, along come Grebe and Sanford and they just make use of that old thing. And all I have said about Gravell using an inhibitor of some particular kind applies to Grebe and Sanford using an inhibitor. And any place. I think it got too late. Unless it would have been a very unusual thing. I don't find anything unusual about the use Grebe and Sanford made of it. I don't see any more novelty, any more difficulty, any more ingenuity with the acid eating the pipe if they wanted to acidize the well and the acid was eating their pipe. I don't see how that could stand in the way any more than the thought I have of its stopping eating the tank or container. And here, so far as the acid is concerned, they say it is eating the rock and then they go back and bring the other in and bring the two together.

In 1896 they had a patent on the eating of the rock

with hydrochloric acid. I don't see anything new. I see a little change in the perfection and all that, but all I can see was invented was just like I say Gravell put something into a tank so it wouldn't eat his tank, and they want to acidize their wells according to the principles of 1896; they just put some of this inhibitor in there. There isn't anything unusual about the inhibitor. Isn't anything unusual about the acid. I can't conceive of anybody having any pipe, worrying much at that stage.

Of course inhibitors have been known now since 1896. They have become better known, different combinations, and so on. Many of them. They found metals that were better inhibitors and developed them and the combinations. You could buy inhibitors as you could a 5c cigar, and that's the way it is, it seems to me. You get a man who wanted to buy hydrochloric acid for this particular purpose it seems to me could be sold in a twinkling of an eye.

It seems to me those two patents fall in the same type. Again, thinking about the purpose of the Patent Office, there we have the purpose to develop an art—not to strangle it; to develop business—not to strangle business. And we had that in 1896, knew how the acid could eat in the well. There was a basic point. It might be old for hydrochloric acid to eat lime. There was a new use; a new place that you can see; that that was knew and worth while. It would have been a pleasure to get a patent like that and enforce it and make people pay tribute to it for seventeen yars. But the time has run on that. That belongs to the people. The principles are no different.

You have a patent there that just runs crosswise against the grains, like the tank does; it is putting it in a different place, but to do the very thing—to inhibit it from eating iron and see what it does. I don't know of a better example of patents strangulating business instead of patents helping business than you have here. We have a Patent Office putting us in this place wherein they gave the right to have the hydrochloric acid eat the rock in the ground, and then in many patents they have given the right and the protection

to inhibit acid so it will not eat iron. And then they start in, as usual in these arts, to run crosswise, to make new combinations, first, of everything they can do—maybe eat the iron a little bit better, this and that, and then they start crosswise of it. That is common in these arts.

And here is a patent if you use this inhibitor and acid in a storage tank to transport it or store it, and here is the other patent to put it down in a well past a tubing, now you can say many of those patents that I have been talking about have run out. But I think of them as not having run out. I think of them as being transferred at the end of seventeen years, and the man who has gotten the patent over to the public. The public use is just as sacred after seventeen years has run as the patentee's privilege or monopoly was during the seventeen years he owned it.

This is the thought I have where they put business, the Patent Office, by this sort of a granting of a patent. They put Halliburton Company in the position, if their patent is held good, where they could haul the acid in an iron tank, save that money and get up to the well where it begins; and then Halliburton is through. They can't go any further towards using that Frasch patent of 1896. So they are interrupted in business.

Let us go over to the Dow. How are they situated? They have to either not use this kind of an inhibitor but they can't haul the acid they want to inhibit if the Gravell patent is good, down there in an iron tank with the arsenic in it and the kind of inhibitor—any kind of an inhibitor they want to. They have to go to the laboratory and try to figure out some sort of thing to get around the Gravell patent or else get a wooden tank—in those days it was more convenient than a steel tank, it was cheaper to get it, more convenient in every way. They can't haul their acid down in a steel tank, but they have to get to the well. And they have to get around Gravell in some way, get it down there.

Now, if that isn't strangling business and doing harm and forcing two fine concerns to get into a row, snoop on each other in business, doing a lot of things they don't want

to do, if those two patents haven't interfered in business, then I don't know my business. These two patents have stood in the way of progress, they have stood in the way of business. It would have been better for the public served, it would have been better for Dow and better for Halliburton, and better for the world if these two patents had never been granted, in my opinion. The cost of it! I can't feel but they worked out just the opposite of the aim of the Patent Office that encourages the development of things for the betterment of the world. I think they had just an opposite result, and the granting of this sort of patents results in that sort of thing. I think we ought to be very, very careful about that.

So, that is in a general rough way now, some of the things, and you can imagine these six weeks I have been making notes here, if I had hung them up and would say all the bad things I have thought of about these patents from the time this suit began down to today, I would keep you here altogether too long, because they are just open to a lot of things.

You can test them out in all these ways. For example, some of the claims of the Grebe-Sanford patent are such that taking them, and, of course, if it was a good patent I readily agree if it was a broad patent like the 96 patent, I would readily find a way of saving it, but just read some of those claims. They are so broad that if Halliburton brought their acid inhibited down to the tank, down to the well in their iron tank, or in any other way that you inhibit it and put it into the well just exactly as Frasch said, the claims will read on it, some of them; of course that is just maybe an over-stepping, but that shows how broad some of those claims are.

And, I don't think it should be measured by that. You say the Grebe-Sanford patent, they talk about that just as if there wasn't any Frasch patent. In order to see Grebe and Sanford at all, you have to just wipe Frasch off from the map and say, "Well, he got a patent, but it wasn't any good and he couldn't do anything." Grebe and Sanford are entitled to just as much credit as if Frasch didn't exist.

Well, that is entirely wrong. The measure of what Grebe and Sanford tried to do, the way they got past the Patent Office, was the measure of not eating the iron, and therefore the measure of its value, if it had one, if it didn't have an inhibitor, the measure of it would be "How much iron did it save and how much acid did it save?" That would be the measure of the benefit of it there. But, I approach it not from that trouble, but from the amount of ingenuity, as I have already said, and here is another thought; I don't know how much I emphasized it, but you take this patent, we get around to where we practically all agree that there is nothing in the world that saves it unless we can say it has had this wonderful success and done wonders for the art. That is what saved it in the Tenth Circuit.

Now, that is a thing that I think this should be emphasized about: The burden of proof is on the owner of the patent to show that sort of thing, surely. And surely if we are going to in the courts be practical now, and reach the right result, we are not going to be satisfied because we see a curve of business, and using after that, we are going to say that it is due to the patent. I say that the burden rests on the plaintiff to eliminate other things that we know make curves of business go up. The world is full of successes and full of failures, and the curve doesn't go down always and men fail because of a patent, and it doesn't always go up to success because of a patent.

Why, the number of things that enter into that are so many that if courts are going to accept a record that just shows an up-going curve and say, "See the wonders that patent is doing," and are going to take a patent that would be held invalid except for that, why, what a dangerous field we are treading on. It just is going to upset the Patent Office, is going to lead it and put it into the hands of big concerns that we want to prosper and be thought well of, and I for one admire those who can succeed, but it is going to work back on the big concern, and it is going to give a monopoly of the patent, a monopoly that is not due, because they are large and capable to take a thing and do

good things with it. You can go and find old patents in the art, undoubtedly, that have run out, and the fellow that has got them—I have seen many of them; nobody picked them up.

If business should take one of those, and prosper with that patent what otherwise wouldn't be patentable, the art is old and the patent is on it so that it is old, but just take a big fine concern with lots of ability, it takes that up and makes it move, I think in all patent cases where that is going to be claimed, that something is to be given to the success of the thing, that the burden should be on the plaintiff urging that, the owner of the patent, to eliminate the other things, so that the court could feel that it is due to the patent.

That is the reason I began early to inquire about those things. And this is a limited field, it isn't as large as some patent medicine case or breakfast food, or some of those things, but we have to again think of the kind of business we are dealing with. Why, a $20,000 ad in the Ladies' Home Journal wouldn't be worth much to Dow. Just in this field is the only place we want it.

We haven't gone into that to show what they are, but if I was going to make findings on those things, I would want to follow this further. If we are going to grant a patent, and that is the only thing, I am going to give it my attention to know how much it is going to cost. Naturally, it is different from selling shoes, or patent medicine, you have to reach everybody, or something of that kind. Here is something that is a limited field. I would want to not only know that, how much it would cost—if I was going to allow this patent on that ground alone, a patent that was applied for earlier, certainly with the passing of years it got easier because inhibitors got better. So, it was easier later than at the time it was granted. It was easier than it was when the inhibitors weren't so well known, and so thoroughly developed, and so easily acquired, and so much talked about. But, if I was going to do that, I would want to know how much it would cost to thoroughly cover that

field. If I am going to grant a patent that would have been, under other circumstances, more difficult to invent, because there wasn't so much known about inhibitors, by going back there and saying I am going to save it because of the developments, then I would want to know how much it cost to thoroughly cover that field where it would do any good, because it wouldn't do any good to advertise it in the town of Leslie. You have to go over to where they are. And, I take it it is a very cheap medium of advertising that you could reach through the grapevine method. I can't think of any product that would be easier to reach the consumer than this, because you have limited fields and know right where it is.

And then we go over to men. I don't think the number ought to control entirely. If I was going to say that I would want to get down into how good the men were, what they did, and what price men they were. Their numbers don't count so much as their price. And, I am just guessing, and it is all right to guess, because the burden of proof is on the plaintiff,—I just imagine that the men selling this stuff are a mighty sight higher paid men than the ones driving the trucks and taking care of the acid. I don't know how that would show as to how much money this concern has spent from beginning to end to get business as compared to how much has been spent making the acid and putting it down the well, but I was just showing, really, the danger in a patent of this kind, that you can see right on the face of it ordinarily, the ordinary individual that thinks about it, that there isn't ingenuity enough to make a patent, but you are going to save them, because of this business.

Why, if I am going to save a patent on that ground, I certainly want to analyze all of the things that tell me so I feel certain that they were due to that patent. I think that must be done, because we are going to go along with a lot of patents in these days of big amounts of sales by any concern that is big and has a product that they can sell. It is very difficult to measure what Dow, with the same effort

put back of this, could have done without an inhibitor, if there hadn't been an inhibitor known. But, as I see it, I don't think there is any proof here of somebody finding that it was so harmful that they stopped. I don't think it is that kind of a case. I am satisfied the same amount of effort to make this well go with the acid uninhibited, wouldn't have done so well, because it would have eaten up some pipe. There isn't any question about that. I am not taking that away from the patent. I don't feel that way about it at all. I think the inhibitor is a fine thing and ought to be used. It is used, and legitimately used, legitimately advertised. It isn't so complete as claimed for it, but enough so that it doesn't do harm to the pipes, and that is what they want.

Well, that is some of the thoughts running through my mind, and I say I have many, many more. I will be thinking of them all night, and the next two or three weeks until I get tied up in that next case down there, and then I will forget all about this case thinking about that.

But, I have been thinking of this all the way through, and you can see my thoughts have all been leading me to think for this reason and that reason, that all three of these patents, it was unfortunate, that they shouldn't have been granted, and the business would have been better without them. It will be better without them. I think everybody will be better without them.

FINDINGS OF FACT

1. This is a civil action arising under the Patent Laws of the United States.

2. Plaintiff, The Dow Chemical Company, is a corporation created and existing under the laws of the State of Michigan, and has its principal place of business at Midland, within the Eastern District of Michigan, Northern Division.

3. Dowell Incorporated is a wholly owned subsidiary of plaintiff, The Dow Chemical Company, engaged in the business of acidizing oil wells within the Eastern District of Michigan, Northern Division, and elsewhere in the United States.

4. Defendant, Halliburton Oil Well Cementing Company, is a corporation created and existing under the laws of the State of Delaware, with a principal place of business at Duncan, Oklahoma, and a regular and established place of business at Mt. Pleasant, Isabella County, Michigan, within the Eastern District of Michigan, Northern Division.

5. Plaintiff is the owner of United States Letters Patent 1,877,504, granted September 13, 1932, and charges that the defendant has infringed claims 1, 5, 7, 8 and 9 of said letters patent, within the Eastern District of Michigan, Northern Division, and elsewhere within the United States.

6. Plaintiff is the owner of United States Letters Patent, 2,024,718 granted December 17, 1935, and charges defendant with infringing claims 1, 2, 3, 6, 7 and 8 of said Letters Patent, within the Eastern District of Michigan, Northern Division, and elsewhere within the United States.

7. Defendant is the owner of United States Letters Patent 1,678,775, granted July 31, 1928, and charges the plaintiff, through its wholly owned subsidiary, Dowell, Inc., with infringing claims 1, 3 and 6 of said Letters Patent.

8. Defendant denies infringement of Letters Patent 1,877,504, and Letters Patent 2,024,718, and asserts that both of said Letters Patent are invalid as to the claims thereof in issue.

9. Plaintiff denies infringement of Letters Patent 1,678,775, and asserts that said Letters Patent are invalid as to all claims thereof.

10. Plaintiff has charged the defendant with infringing United States Letters Patent 1,916,122, granted June 27, 1933, and Letters Patent 1,998,756, granted April 23, 1935, but the parties have stipulated as to the provisions of the judgment or decree to be entered in this cause with respect to said two Letters Patent, and the court has been relieved of deciding any issues relative thereto.

PATENT 1,678,775

11. Letters Patent 1,678,775 are directed to the storage and transportation of acid solutions such as attack steel in steel or iron containers or drums instead of glass or specially lined containers.

12. The acid solutions which may be so stored and transported in steel or iron containers in accordance with the invention are identified in the patent as follows:

"Although the invention applies to acid solutions generally, it is particularly useful in connection with solutions of sulphuric, hydrochloric and phosphoric acids."

13. The patent is predicated upon an alleged discovery stated to have been made by the inventor as follows:

"The invention is based on the discovery that acid solutions containing certain metals with or without so-called pickle control substances or acid regulators, when brought into contact with steel and iron, automatically form or deposit a protective coating on the inner surface of the container which acts to prevent the acid solution from attacking the container."

14. The metals which may be so employed are identified in the patent as follows:

"The metals which have that property are below iron and above mercury in the electromotive scale. Under certain conditions tin produces good commercial results. However, arsenic in most cases is more satisfactory."

15. The pickle control substances or acid regulators which may be employed, are identified in the patent as follows:

"Examples of pickle control substances or acid regulators are crude anthracene, sulphite lye residues from the production of naphthalene, acid resins, waste acids from refining hydrocarbons, residues from the distillation of organic compounds, cyanides, liquid obtained from boiling bran and other starchy materials in water, sodium bisulphate, hydrocarbon tars, alcohols such as methyl, ethyl, propyl, amyl, butyl, etc., higher alcohols including glycerine, cellulose pulp waste, sumac leaves, gelatine, remains from the distillation of anthracene, distillates from gelatine by itself or with fats, organic bases, and aldehydes.

"The distillate from gelatine and fat consisting of various materials including organic bases such as pyridine bases and the like, produces excellent results and therefore will be selected in this description as a typical acid regulator or pickle control although other controls or regulators may be substituted."

16. The ability of many metals, including tin and arsenic, when added to acid solutions, to automatically form or deposit a protective coating on iron or steel was known in the art prior to Letters Patent 1,678,775.

17. Metals having this ability, including tin and arsenic, were known, prior to Letters Patent 1,678,775, to inhibit or reduce the rate of corrosion of iron or steel by some acids, including hydrochloric acid and dilute sulphuric acid.

18. Many and most of the pickle control substances or acid regulators mentioned in the patent were known and commonly used in pickling baths and plating solutions prior to Letters Patent 1,678,775.

19. Prior to Letters Patent 1,678,775, acid solutions, such as hydrochloric acid and dilute sulphuric acid which actively attack steel, had not been stored or transported in steel or iron containers or drums.

20. Gravell, in Letters Patent 1,678,775, was the first to disclose that by the addition of known inhibitors capable

of precipitating a protective coating on steel, such corrosive acid solutions which actively attack steel could be successfully stored or transported in steel or iron containers or drums.

21. The discovery of Gravell has been employed successfully on a large commercial scale under Letters Patent 1,678,775.

22. The prior art does not disclose the composition of matter specifically described and claimed in Claims 3 and 6 of Letters Patent 1,678,775 comprising an admixture of arsenic compound and an acid regulator.

26. In November, 1936, defendant opened negotiations with American Chemical Paint Company for a license under the patent. These negotiations eventuated in an agreement dated February 8, 1939, whereby American Chemical Paint Company agreed to assign the patent to defendant, Halliburton, for the sum of $1,000 in cash, and an agreement to give back to American Chemical Paint Company a paid-up license and to pay it a royalty of 75c a gallon on all inhibitors made or sold under the patent by defendant or its licensees. The patent was assigned to defendant by an instrument dated February 10, 1939, four months and four days before this suit was brought by plaintiff against defendant.

27. At least since 1923 American Chemical Paint Company has been continuously a manufacturer of inhibitors and other products of acid character which were originally shipped in wood or glass containers. Since the time of the Gravell invention some of its products (Deoxidyne, Deoxylyte and some Rodines), have been shipped in steel containers. Others of its products (Murodine, Chlorodine, Scalene, and some Rodines), however, have been shipped in wood or glass containers. It has not shipped hydrochloric acid, inhibited according to the patent, in steel containers, but some of its products which have been shipped in steel containers are inhibitor concentrates which contain a substantial percentage of hydrochloric acid.

29. Not all of the metals "below iron and above mer-

cury" are effective in protecting a steel surface from attack by acid. For example, nickel and cobalt are not effective.

30. Many of the materials called in the patent "acid regulators" were known in the prior art as inhibitors for pickling acids, and defendant makes no claim that the patentee discovered their use for the purpose and admits that the acid regulators mentioned in the patent were copied from the prior art.

31. When an operative metal or metal compound of the class defined by the patent is dissolved in an acid, and the acid is brought in contact with an iron surface, as of a steel container, the dissolved metal in the acid is precipitated on the iron surface to form a protective coating or film which acts to prevent attack by the acid. This action is contact plating by immersion without an external electric current. The prior art shows the contact plating of iron and steel in acid solutions of many of patentee's (Gravell's) metal e.g. tin, arsenic, antimony, bismuth, copper. The prior art also shows the contact plating of iron with antimony and bismuth from acid solutions containing also an aldehyde, one of the acid regulators of the (Gravell) patent (Watts, 1919) and the contact plating of iron with an acid solution of copper containing alcohol, another of Gravell's acid regulators (Iron Age, 1874).

32. Electroplating of metals is similar to contact plating, except that the former makes use of an external electric current. The chemical action in either case is the same. It was known in the prior art to add to electroplating solutions of a metal dissolved in the same, organic agents, described as acid regulators in the patent, such as glue, gelatin, glycerine and many others. These electroplating baths contain an acid corrosive to iron and steel, an acid regulator, and a metal within the range specified by the Gravell patent, and were used to deposit a protective coating of metal on iron.

33. In many cases iron and mercury reduce the corrosive action of acids on iron or steel to as great an extent as do some metals which lie between iron and mercury in the electromotive series.

36. In many cases the metals lying between iron and mercury in the electromotive series accelerate the corrosive action of acids on iron and steel.

37. In many cases various combinations of a metal lying between iron and mercury in the electromotive series and one of the pickle control substances named in the Gravell patent, when placed in an acid solution, make the same more corrosive to iron and steel than the raw acid, and in many other cases such combinations make the solution more corrosive to iron and steel than it would be without the presence of the metal.

38. Arsenic generally is the best of all the inhibitors for hydrochloric acid, and yet the addition of arsenic to hydrochloric acid in some instances, with small amounts of arsenic in high concentrations of hydrochloric acid, makes the solution a little more corrosive than is the raw acid alone.

39. In some cases steel containers of hydrochloric acid, plus arsenic and an acid regulator (sodium bisulfate, sodium cyanide or rosin), failed more quickly than did others containing the raw acid alone.

40. In some cases drums containing a solution of arsenic, sulphuric acid and organic bases failed more quickly than did similar drums containing sulphuric acid and organic bases without the arsenic.

41. In the one test of a 55-gallon drum containing arsenic and hydrochloric acid the drum failed more quickly than did a similar drum containing the raw acid alone.

42. Hydrochloric acid is generally manufactured and sold in strengths of 18° Baume, 20° Baume and 22° Baume acid and in such strengths is one of the most corrosive of the acids to iron and steel.

43. The Interstate Commerce Rules governing the shipment of acids in interstate commerce do not permit the shipment of inhibited hydrochloric acid of any strength in unlined steel drums or containers. On the contrary, they require all hydrochloric acids to be shipped in glass or earthenware jars or in rubber lined drums, barrels or tank cars.

44. Sulphuric and phosphoric acids containing the exact proportions of arsenic and an acid regulator specified in the Gravell patent (page 2, lines 61 to 63 and lines 24 to 27) when placed in I. C. C. returnable drums sealed for shipment caused failure in from 2 to 12 days. The patent gives no specific example of an inhibited hydrochloric acid but does mention a solution containing inhibitors and 75% hydrochloric acid.

47. The process and composition claimed by Gravell were developed to meet a specific problem incident to the storage and shipment of some of the products manufactured and sold by American Chemical Paint Company to the pickling and automobile industries.

48. No licenses have been granted under the Gravell patent, save only the license back to American Chemical Paint Company from defendant when the legal title to the patent was assigned to defendant.

49. Defendant has paid no royalties to American Chemical Paint Company, as provided in the agreement of February, 1938, between American Chemical Paint Company and defendant.

50. As recited in the Gravell patent, the terms "pickle control substances or acid regulators," include organic bases and taken literally comprise thousands of compounds.

51. The Gravell patent recites five specific examples, of which two fail to recite the concentration of the acid, and all of which fail to identify the term "organic bases" wherever the same is recited.

52. Neither the examples of the specification nor the claims of the Gravell patent taken literally identify the term "organic bases."

53. The hydrochloric acid employed by plaintiff in acidizing oil wells is transported to the wells to be acidized in steel transportation tanks and is conducted down the well through a steel pipe.

54. Plaintiff's subsidiary, Dowell Incorporated, adds to the hydrochloric acid before transportation to the well an inhibitor (sodium arsenite) and an acid regulator (alcohol).

PATENT No. 1,877,504

55. The validity of Letters Patent 1,877,504 has been sustained by the United States Circuit Court of Appeals for the 10th Circuit, in Dow Chemical Co. vs. Williams Brothers Well Treating Corporation, 81 Fed. (2) 495, reversing the decision of the United States District Court for the Northern Division of Oklahoma. But the record before this court here contains a large amount of new evidence not before the courts in that case, and this new evidence is of such a character that it may fairly be concluded that the Circuit Court of Appeals for the 10th Circuit would have reached a different conclusion had it been advised of its existence.

56. A substantial part of the crude oil deposits in the United States is in calcareous rock, limestone (calcium carbonate ($CaCO_3$)) or dolomite (a mixture of calcium carbonate with magnesium carbonate, $MgCO_3$). Limestone and dolomite are readily soluble in dilute hydrochloride acid (HCl) with the production of the corresponding chloride ($CaCl_2$ and $MgCl_2$) and the evolution of carbon dioxide gas (CO_2).

57. Physically, the oil bearing rocks vary widely. Some are quite finely porous, the oil filling the pores and clinging to their walls, while others have considerably larger oil filled openings. The underground oil is usually under such pressure that it will flow, more or less rapidly, to a place of reduced pressure, such as exists at the bottom of a well. The pressure is sometimes sufficient to force the oil up the well to the surface, sometimes only enough to cause it to flow or seep into the well from which it must be pumped, and sometimes it is so low that suction must be maintained on the well to assist the oil flow to it.

58. Oil wells are drilled to the oil bearing stratum or "pay." Each is surrounded by a steel casing, often 6 inches in diameter, rising to the ground level from a point above the "pay," leaving an open hole at the bottom into

which the oil flows. Within the casing is the tubing (usually of 2 or $2\frac{1}{2}$ inch soft steel pipe) which extends below the casing into the open hole and carries at its lower end the working barrel and stationary valve of the pump. Within the tubing is the pump rod carrying the valved piston of the pump. The reciprocation of the rod pumps to the surface any oil which has flowed into the hole.

59. Since a single well must drain the oil from a considerable area around it, it is evident that the flow of oil, which may be very slow at a distance from the well, must become constantly faster as it nears the well, since the relatively few openings near the well must carry the oil, which, further away, are carried by a much larger number of openings. The "bottle neck" limiting production is the ability of the ground pressure to force the oil into the congested zone close to the hole. Furthermore, the convergence of oil from all directions in this zone tends to plug it with anything the oil may carry, such as physical dirt or paraffin wax.

60. Not only is the daily production of a well limited by the carrying capacity of the immediately adjacent "pay," but also the economic life of a well ends when the flow to it becomes so small as no longer to justify its operation. This reduction of flow may arise either because the pay immediately around the hole becomes plugged up, or because the decreasing ground pressure will no longer force the oil through this congested area, or both.

61. It is of great importance to increase the ultimate total production of the well by making it possible for the ground pressure to force a large proportion of the total oil into the hole.

62. Long prior to the date of application for the Grebe-Sanford patent in suit it was a well known fact of chemistry that sulphuric acid and hydrochloric acid would attack and decompose limestone. The action of sulphuric acid solution on limestone consumes the acid and produces carbon dioxide gas and calcium sulphate, which is insoluble and is precipitated in the solution, such precipitation tend-

ing to cover the face of the limestone and prevent further action of the acid on it. A hydrochloric acid solution acts on limestone and is consumed to produce carbon dioxide gas and calcium chloride, which is very soluble in the solution, and hence, does not tend to stop the action of the acid by formation of a precipitate.

63. It was also well known long prior to the date of application for the patent in suit that solutions of sulphuric acid and hydrochloric acid likewise act upon iron, steel and other metals, corroding and dissolving them.

64. The Frasch patent No. 556,669, issued in 1896, describes acidizing an oil well with uninhibited hydrochloric acid.

65. According to the invention in suit, an inhibitor is added to the acid. Inhibitors, per se, were very old and well known many years before Grebe and Sanford, and were known to chemists before Frasch's time. Inhibited acid attacks limestone and dolomite as freely as before but its attack on iron is greatly reduced (and in some cases almost wholly prevented). In treating a well by the Grebe and Sanford process the pump rod and its moving valve are withdrawn and the acid is forced down the regular tubing and pump barrel (cylinder) and out into the pay.

66. Prior to the date of the application for the patent in suit, the Gypsy Oil Company had a problem in the Glenpool field, in Oklahoma (a sand formation), caused by formation of "gyp" scale on the casing, tubing, working barrel and pump rods of an oil well, which formation interferred with pumping of the well, and necessitated frequent shut-downs and loss of time for removing rods, valves, etc., and cleaning off the scale. A suitable scale solvent was sought which could be used in the wells to remove scale and thereby to avoid the frequent "pulling" jobs. The problem was submitted to the Mellon Institute at Pittsburgh, the result of tests made at the Institute being contained in a report by Dr. Wescott. The report, while not made public, recommended the use of hydrochloric acid as the scale solvent, and the addition of Rodine, an inhibitor, to the acid

to prevent its attack upon the metal parts of the well. The report also suggested that the use of the acid in the well might also remove gyp from the face of the sand and thereby increase production.

67. In the years 1928 and 1929 the Gypsy Oil Company introduced solutions of hydrochloric acid containing Rodine inhibitor into three of its oil wells located in the Glenpool in Oklahoma. All of said wells were producing oil from the Glenn sand, which is the same as the Bartlesville sand, a member of the Pennsylvania series, and is primarily silica with about 5 per cent calcium carbonate. The three wells above referred to were as follows:

William Berryhill Well No. 8 treated November 12, 1928.

Thomas Gilcrease Well No. 22 treated September 4, 1929.

William Berryhill Well No. 11 treated September 11, 1929.

During such period and subsequent thereto other wells in sand formations were treated by the Gypsy Oil Company with uninhibited hydrochloric acid for scale removal.

68. The claims in issue of Letters Patent 1,877,504 are directed to a purported method for increasing the output of an oil well, which comprises introducing into the well to act upon the formation a hydrochloric acid solution containing or to which has been added a small amount of a corrosion inhibitor or agent capable of inhibiting the action of the acid upon metals, and subsequently withdrawing the spent acid from the well.

69. Dowell Incorporated, on February 10, 1933, treated the Gypsy Oil Company's Well Lovett No. 1 by injecting hydrochloric acid into the formation thereof and this was the first well so treated which was owned by Gypsy Oil Company producing from a limestone formation.

70. Prior to 1932, large amounts of oil were being produced from limestone formations in many states of the United States.

71. The method of acidizing disclosed in the prior

patent to Frasch, 556,669 granted March 17, 1896, was successfully used on a commercial basis in the acidizing of a number of wells near Lima, Ohio, in 1895.

72. The acidizing of oil wells with hydrochloric acid to increase the production of the wells was suggested to the applicants for Letters Patent 1,877,504 by representatives of the Pure Oil Company and was not original with or conceived by such applicants.

73. Prior to Letters Patent 1,877,504, it was well known that numerous agents, including the preferred agent (arsenic compounds) mentioned in Letters Patent 1,877,504, could be added as inhibitors to hydrochloric acid to reduce the corrosive action of the acid upon metals such as steel.

74. Such an inhibitor was added to hydrochloric acid by the Gypsy Oil Company in 1928 for the purpose of reducing the corrosive action of the acid upon the steel pipe and equipment in three wells in sandstone formations when introducing the acid into the wells, the object of this treatment being to remove calcareous scale and deposits therefrom. Such use of hydrochloric acid containing a corrosion inhibitor was reduced to successful commercial practice by the Gypsy Oil Company in 1928 and was not a mere abandoned experiment.

75. The addition of corrosion inhibitors to corrosive acids, including hydrochloric acid, to provide for safely storing and transporting such acids in steel drums or containers is disclosed in the prior patent to Gravell, 1,678,775, granted July 31, 1928, and large quantities of phosphoric acid and pickle control substances containing corrosion inhibitors were shipped commercially by American Chemical Paint Company under such Gravell patent, 1,678,775, long prior to Letters Patent 1,877,504.

76. In adding a corrosion inhibitor to hydrochloric acid for use in acidizing wells, plaintiff was merely making use of the well known qualities of such corrosion inhibitors and obtained no new or unexpected result.

77. The addition of a corrosion inhibitor to the hydrochloric acid employed in an oil well acidizing process creates

no new process of acidizing a limestone formation, and the use of such an inhibitor in an oil well acidizing process is not essential and does not affect the action of the acid upon the formation.

78. The rate of corrosion of raw commercial hydrochloric acid upon steel does not result in any material damage to the well pipe or equipment in the well during a great majority of the usual commercial acidizing operations.

79. Many wells have been acidized successfully with commercial hydrochloric acid using no corrosion inhibitor before and since Letters Patent 1,877,504 issued.

80. It is not established that anyone interested in acidizing a well was ever deterred from so doing by the fear of injury to his well pipe or well equipment or by his inability to resort to the use of well known corrosion inhibitors.

81. The addition of a corrosion inhibitor to hydrochloric acid employed in acidizing an oil well required no more than the ordinary skill of the calling and involved no patentable invention upon the part of the applicants for Letters Patent 1,877,504.

82. Plaintiff, in 1932, was the first to treat the producing formation of a limestone well with inhibited hydrochloric acid charged into the well through the pump tube.

83. Defendant inhibits the hydrochloric acid used in its business of treating wells by the presence in the acid of dissolved lead and copper.

84. Defendant has within six years prior to the filing of the complaint herein, treated oil wells by charging into the well tube, by means of a pump, an inhibited hydrochloric acid solution of about fifteen per cent concentration, expelling such acid solution into the bore of the well to act upon the rock formation surrounding the well cavity, and withdrawing the spent acid.

85. The hydrochloric acid solution employed by defendant in treating oil wells for the Weber Oil Company, in the Eastern District, Northern Division of Michigan, was inhibited due to the presence therein of an agent capable of inhibiting the action of hydrochloric acid on metals.

86. The hydrochloric acid employed by defendant in acidizing oil wells is transported in steel transportation tanks from defendant's storage tanks to the wells to be acidized.

87. The storage-tank acid employed by defendant is commercial hydrochloric acid to which defendant adds no corrosion inhibitor or agent capable of inhibiting the action of the acid upon metals, unless the formation of metallic chlorides (lead and copper), in the transportation tanks, as hereinafter described, be deemed such addition.

88. Defendant bonds a lead plate within the tanks to the steel, thereby producing a battery action causing a flow of electric current from the lead plate through the acid to the steel walls of the transportation tank, and it has been established that this flow of current protects the steel of the transportation tanks.

89. Analyses by plaintiff of raw commercial hydrochloric acid from different manufacturers show traces of copper and lead chlorides and commercial hydrochloric acid containing such chlorides is less corrosive than chemically pure hydrochloric acid.

90. The battery action in defendant's transportation tanks results in the formation of additional minute amounts of copper, lead, and iron chlorides incidental to the operation of defendant's method of protecting its transportation tanks.

91. The presence of such minute quantities of copper, lead, and iron chlorides in the defendant's well acid reduces the corrosive action of the acid, but such acid is more corrosive than the acid resulting from following the example given at lines 74 to 78, page 2 of Letters Patent 1,877,504.

CONCLUSIONS OF LAW

1. Claims 1, 5, 7, 8, and 9, of Letters Patent 1,877,504 are invalid.

2. Defendant would have infringed claims 1, 5, 7, 8, and 9, of Letters Patent 1,877,504 if valid.

3. Claims 1, 2, 3, 6, 7, and 8, of Letters Patent 2,024,718 are invalid.

4. Defendant would have infringed claims 1, 2, 3, 6, 7, and 8, of Letters Patent 2,024,718, if valid.

5. Claims 1, 3, and 6, of Letters Patent 1,678,775, are invalid.

6. Plaintiff would have infringed claims 1, 3, and 6, of Letters Patent 1,678,775, if valid.

DECREE

This cause having been fully tried in open court and the court having made and entered its findings of fact and conclusions of law herein, it is hereby adjudged and decreed as follows:

1. That the complaint be and the same is hereby dismissed as to Letters Patent 1,877,504.

2. That the complaint be and the same is hereby dismissed as to Letters Patent 2,024,718.

3. That, as stipulated, the Grebe patent 1,916,122

issued to plaintiff, The Dow Chemical Company, on June 27th, 1933, for method of treating wells with acid, is good and valid in law and has been the property of plaintiff at all times since it issued.

4. That, as stipulated, the Grebe and Stoesser patent 1,998,756 issued to plaintiff, The Dow Chemical Company, on April 23, 1935, for treating of deep wells, is good and valid in law and has been the property of plaintiff at all times since it issued.

5. That defendant, Halliburton Oil Well Cementing Company, has infringed said Grebe patent 1,916,122.

6. That defendant, Halliburton Oil Well Cementing Company, has infringed said Grebe and Stoesser patent 1,998,756.

7. That in accordance with the stipulation between the parties herein, plaintiff is not entitled in this decree to an order for an accounting of the damages it has sustained and of the profits defendant has received on account of the defendant's infringement of said patents 1,916,122 and 1,998,756.

8. That, as stipulated, an injunction be entered herein enjoining defendant Halliburton Oil Well Cementing Company and its officers and employees from further infringement of said Letters Patent 1,916,122 and 1,998,756, or either of them.

9. That the counterclaim be and the same is hereby dismissed as to Letters Patent 1,678,775.

10. That each party pay its own costs incurred in this action.

Sgd. Arthur J. Tuttle,
United States District Judge.

Dated: September 10, 1941.

NOTICE OF APPEAL

(Filed December 9, 1941)

Notice is hereby given that The Dow Chemical Company, plaintiff herein, hereby appeals to the Circuit Court of Appeals for the Sixth Circuit from the provisions of paragraphs numbered "1" and "2" of the decree entered herein on the 10th day of September, 1941, which dismiss the complaint as to Grebe and Sanford Patent 1,877,504 and as to Chamberlain Patent 2,024,718.

Calvin A. Campbell,
Attorney for Plaintiff, The Dow
Chemical Company.

ORDER

The Dow Chemical Company, plaintiff, having on December 9, 1941, filed its notice of appeal herein, for good cause shown it is hereby ordered that appellant's time for filing the record on appeal in the Circuit Court of Appeals for the Sixth Circuit and for docketing the appeal in that court be and the same is hereby extended to the 7th day of March, 1942.

Arthur J. Tuttle,
United States District Judge.

Bay City, Michigan, January 15, 1942.

ORDER

Upon consideration of a petition by the above-named appellant for an extension of time, sixty days beyond March 7, 1942, within which to file the record and docket the appeal in the above cause,

It Is Ordered That the motion be and it is hereby granted.

Approved for entry:

Charles C. Simons,
United States Circuit Judge.

Filed: March 4, 1942.

ORDER

It is ordered that the time for filing record and docketing appeal be extended for a period of ninety days beyond May 6, 1942, pursuant to agreed motion of counsel.

Approved for entry:

Xen Hicks,
Circuit Judge.

Filed: May 6, 1942.

STIPULATION

In view of the situation set forth in a letter written by Chittenden Press to J. W. Menzies, Clerk, United States Circuit Court of Appeals, dated July 13, 1942, copy of which is attached hereto, it is hereby stipulated that the time for filing the record and docketing the appeal herein be extended for a period of three (3) months beyond August 4, 1942.

(S) Wilber Owen,
Of Counsel for Plaintiff-Appellant.
(S) Leonard S. Lyon,
Of Counsel for Defendant-Appellee.

Approved:
Xen Hicks,
Circuit Judge.
Filed: July 18, 1942.

STATEMENT OF POINTS ON WHICH PLAINTIFF-APPELLANT INTENDS TO RELY ON APPEAL

On the appeal, plaintiff-appellant will rely on the following points:

1. The District Court erred in dismissing the complaint as to Grebe and Sanford Patent No. 1,877,504.

2. The District Court erred in failing to decree that Grebe and Sanford Patent No. 1,877,504 is good and valid in law, and particularly Claims 1, 5, 7, 8 and 9 thereof.

3. The District Court erred in not following the decision of the United States Circuit Court of Appeals for the Tenth Circuit in The Dow Chemical Company vs. Williams Brothers Well Treating Corporation, reported at 81 F. (2d) 495, on the question of validity of Grebe and Sanford Patent No. 1,877,504, and in finding as a fact that the record herein contains a large amount of new evidence not before the court in that case and that this new evidence is of such a character that it may fairly be concluded that the Circuit Court of Appeals for the Tenth Circuit would have reached a different conclusion had it been advised of its existence.

4. The District Court erred in failing to find that the evidence before it that was not before the court in The Dow Chemical Company vs. Williams Brothers Well Treating Corporation is insufficient to warrant a different conclusion on the question of validity of the Grebe and Sanford Patent No. 1,877,504 than that reached by the Tenth Circuit Court of Appeals.

5. The District Court, having found infringement, erred in failing to decree the issuance of an injunction against defendant, Halliburton Oil Well Cementing Company, permanently enjoining it from further infringement of said Grebe and Sanford Patent No. 1,877,504.

6. The District Court, having found infringement, erred in failing to decree an accounting by defendant of the profits and advantages that have accrued or that may hereafter accrue to it as a result of its infringements of said

Grebe and Sanford Patent No. 1,877,504, and of the damages plaintiff has sustained or may hereafter sustain by reason of defendant's said infringements.

7. The District Court erred in finding that in adding a corrosion inhibitor to hydrochloric acid for use in acidizing wells, plaintiff was merely making use of the well known qualities of such corrosion inhibitors and obtained no new or unexpected result, and in not finding that the method disclosed and claimed in Grebe-Sanford Patent No. 1,877,504, produced a new and unexpected result which had never before been known or obtained.

8. The District Court erred in finding that the addition of a corrosion inhibitor to the hydrochloric acid employed in an oil well acidizing process creates no new process of acidizing a limestone formation, and in not finding that the step of adding a corrosion inhibitor in an oil well acidizing process for limestone formations together with the elimination of other steps of the acidizing process of the prior art created a new and patentable process which resulted in a new industry in which such inhibiting step was the principal contributing factor.

9. The District Court erred in basing any conclusion of law on the finding that the rate of corrosion of raw commercial hydrochloric acid upon steel does not result in any material damage to the well pipe or equipment in the well during a great majority of the usual commercial acidizing operations, and in not finding that the use by defendant of inhibited hydrochloric acid precludes it from attacking the utility of such process, and that the degree of utility of the Grebe-Sanford process has no effect on the validity of the patent.

10. The District Court erred in finding that many wells have been acidized successfully with commercial hydrochloric acid using no corrosion inhibitor both before and since Letters Patent No. 1,877,504 issued, and in failing to find that the proofs do not establish any successful commercial use of uninhibited hydrochloric acid for acidizing wells in limestone formation to increase their production.

11. The District Court erred in finding that the method disclosed in the Frasch Patent No. 556,669 was successfully used on a commercial basis in the acidizing of a number of wells near Lima, Ohio, in 1895, and in failing to find that said patent disclosed a commercially impractical and unsuccessful method for increasing the flow of oil wells and that the attempts of the owners of said patent to practice said method were abandoned after a short trial period.

12. The District Court erred in failing to find that the process of the Frasch patent, even if conducted with inhibited hydrochloric acid, would not be the equivalent of the Grebe and Sanford process.

13. The District Court erred in basing any conclusion of law on the finding that it is not established that anyone interested in acidizing a well was ever deterred from so doing by the fear of injury to his well pipe or well equipment or by his inability to resort to the use of well known corrosion inhibitors, and in not finding as a fact that since about the year 1897 no wells in limestone formations were successfully treated with hydrochloric acid prior to the Grebe-Sanford invention, and that the fact that no wells were ever so treated with inhibited acid is evidence that the process of Grebe and Sanford constituted a patentable invention.

14. The District Court erred in finding that the use of hydrochloric acid to which had been added an inhibitor for the purpose of reducing the corrosive action of the acid upon the steel pipe and equipment in three wells in sandstone formation, with the object of removing calcareous scale and deposits therefrom, was reduced to successful commercial practice by the Gypsy Oil Company in 1928 or at any other time prior to the invention of the process of the patent in suit by Grebe and Sanford, and in failing to find that such use by the Gypsy Oil Company was a mere abandoned experiment.

15. The District Court erred in finding that the addition of a corrosion inhibitor to hydrochloric acid employed in acidizing an oil well, for the purpose of increasing pro-

duction, required no more than the ordinary skill of the calling and involved no patentable invention upon the part of the applicants for Letters Patent No. 1,877,504, and in not finding that the process described and claimed in said patent constituted a patentable invention as tested both by the history of the art and commercial success.

16. That the District Court erred in failing to decree a recovery from defendant of that portion of plaintiff's costs incurred in connection with its case on the Grebe-Sanford Patent No. 1,877,504 and its defense against defendant's counterclaim.

Wilber Owen,
Don L. Conner,
Attorneys for Plaintiff-Appellant.

Vol. IV

TRANSCRIPT OF RECORD

(Pages 1501 to 2078)

Supreme Court of the United States

OCTOBER TERM, 1944

No. 50

THE DOW CHEMICAL COMPANY, PETITIONER,

vs.

HALLIBURTON OIL WELL CEMENTING COMPANY

No. 61

HALLIBURTON OIL WELL CEMENTING COMPANY, PETITIONER,

vs.

THE DOW CHEMICAL COMPANY

ON WRITS OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SIXTH CIRCUIT

PETITIONS FOR CERTIORARI FILED { APRIL 6, 1944. APRIL 17, 1944.

CERTIORARI GRANTED MAY 15, 1944.

Supreme Court of the United States

OCTOBER TERM, 1943

No. 355

THE DOW CHEMICAL COMPANY, a Corporation,
Petitioner,

vs.

HALLIBURTON OIL WELL CEMENTING COMPANY,
a Corporation,
Respondent.

Transcript of Record

On Petition for Writ of Certiorari to the United States Circuit Court of Appeals for the Sixth Circuit

Volume IV—Pages 1501 to 2077
PROCEEDINGS IN THE UNITED STATES CIRCUIT COURT OF APPEALS — SIXTH CIRCUIT

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IN THE

UNITED STATES CIRCUIT COURT OF APPEALS

FOR THE SIXTH CIRCUIT

No. . . . .

The Dow Chemical Company, a Corporation,
Plaintiff-Appellant,

vs.

Halliburton Oil Well Cementing Company,
a Corporation,
Defendant-Appellee.

Appeal from the United States District Court for the Eastern District of Michigan, Northern Division

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Plaintiff's Exhibits

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Plaintiff's Exhibits

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Plaintiff's Exhibits

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Plaintiff's Exhibits

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Defendant's Exhibits

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PLAINTIFF'S EXHIBIT 10½

ENGINEERING SOCIETIES LIBRARY
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Memoir on the Decomposition of Water by Metals, in the Presence of Acids and Salts.
By E. Millon

(Translated from Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, vol. 21 (1845) (p37-50)

The impairment of metals, either by pure water or by water charged with acid or saline principles, is a phenomenon that occurs frequently in the laboratory: this phenomenon also concerns our domestic uses and, among industrial facts, it certainly has an important place.

The experiments that I am about to describe are all connected with this impairment of metals by water in the presence of acids or salts; they only comprise, in a word, a simple indication of some circumstances under whose action the common metals, iron, zinc, tin, copper, are attached and sometimes preserved. But among all these circumstances, there is one that I shall point out at once, because I think its intervention has been almost unnoticed heretofore: I wish to call attention to the influence of small quantities.

This influence, if I do not mistake the first impression that I have received is considerable.

If one should say, indeed, that a little quantity of metallic solution, added in the proportion of one thousandth, of one hundred-thousandth, and often in a smaller proportion, was sufficient to increase a hundred fold the action of an acid on a metal, or to annihilate this action, or to provoke it when it did not exist, or finally even to change the nature of the products to such a point that hydrogen replaces nitrous compounds, one would seem to be, in such

an assertion, as far from the facts as from chemical predictions.

Nevertheless, that is what happens.

The details of the experiments will show how easy it is to reproduce all these phenomena.

Of zinc and the decomposition that it exerts, by means of small metallic quantities, on acid or saline solutions or on pure water itself.

Zinc and sulfuric acid.—Several chemists have already reported the peculiar resistance that zinc sometimes opposes to the solvent action of dilute sulfuric acid. The usual disposition is to attribute this resistance to the purity of the metal, which will not decompose water readily but by means of some foreiga metal combined with the zinc. Here, the phenomenon has been considered in a different manner: the metal has been taken as it is found in commerce, while the acid, saline water or pure water itself has received a small quantity of foreign saline solution before being brought in contact with the zinc.

Thus, rolled zinc has been brought into the presence of dilute sulfuric acid to which has been added some traces either of platinous chloride, or of tartar emetic, arsenious acid, copper sulfate, silver sulfate, etc. The metal, weighed before the reaction, was weighed again after the reaction had lasted for a definite time. In other instances, the gas was collected and measured.

I shall indicate the principal conditions of the experiments made by means of zinc and dilute sulfuric acid.

The zinc was rolled in sheets thin enough to give 100 to 102 cm. of surface per weight of 15 grams.

The sulfuric acid was composed of 1 part of monohydrated sulfuric acid SO_3H_2O to 12 parts of distilled water.

The zinc was weighed exactly, and six nearly equal quantities of water were introduced into six glass flasks, each of which contained 1½ deciliters of the one-to-twelve sulfuric acid; the flasks were distinguished by the numbers 1, 2, 3, 4, 5 and 6.

In flask no. 1, the acid remained pure; no. 2 received 4

drops of platinous chloride solution made with 1 part of chloride and 10 parts of water; nos. 3, 4, 5 and 6 received some drops of saturated solutions of tartar emetic, arsenious acid, copper sulfate and silver sulfate.

The duration of the experiment was 10 minutes for each flask.

Iron and Tin

Iron and tin have been subjected to tests analogous to those of zinc.

One-to-twelve sulfuric acid dissolves iron turnings rather rapidly; some drops of platinous chloride communicate an extreme intensity to this action. Arsenious acid, on the contrary, stops all action on iron by sulfuric acid; this influence is sufficiently pronounced for the metallic iron to keep for a whole month, and without doubt still longer, in one-to-twelve sulfuric acid, which dissolves it rather rapidly. When the iron is well cleaned, some drops of an aqueous solution of arsenious acid are sufficient to preserve it from the acid; at the same time it preserves metallic reflection whose shade becomes only rather darkened.

Tartar emetic slackens the action of sulfuric acid on iron, but does not stop it. Mercurous chloride acts like tartar emetic. Copper sulfate accelerates strongly the evolution of hydrogen; silver sulfate also accelerates it, but less appreciably.

Hydrochloric acid receives, from small quantities of metals, the same influence as dilute sulfuric acid; these reactions can even be observed with rather concentrated hydrochloric acid; it is sufficient to dilute the pure fuming acid with 2 or 3 volumes of water. In some cases the addition of a small quantity of copper sulfate has suspended very appreciably the action of hydrochloric acid. The iron becomes covered with metallic copper and remains for several hours without furnishing hydrogen; but it has not always been thus, without it being possible to ascertain whether this difference depended on the hydrochloric acid or the iron.

* * * * *

THE JOURNAL OF THE SOCIETY OF CHEMICAL INDUSTRY
(April 30, 1901)

THE RATE OF DISSOLUTION OF IRON IN HYDROCHLORIC ACID

By James T. Conroy, B.SC., Ph.D.

The behaviour of acids towards metals is a problem of great interest, both to the chemist and the manufacturer, and such behaviour has been the subject of considerable investigation.

Sometimes, perhaps most frequently, it is the manufacturer's object to obtain a metal not acted upon by some particular acid; at other times action is desired, and in this case a knowledge of the course of the reaction, its rate, and the conditions under which it occurs is of the greatest importance.

To take a particular instance, I may refer to the cleaning of iron by acids—the so-called "pickling" process—a preliminary operation in the preparation of this metal for the galvanising bath. In an industry of this nature, where the various units of plant for the several operations are designed to deal with the same quantity of material, and will do so under certain definite conditions, the importance of knowing and being able to control these conditions will be readily recognised. That these conditions are not always known, even in large and prosperous works, I have had opportunity to learn. As a matter of fact, the present investigation arose out of the marked difference in the work done on a manufacturing scale by acids of equal chemical purity. The only apparent differences in the conditions at the starting of the pickling operation were in the concentration of the acids and the temperatures of the two baths, and these differences appeared almost too slight to account for the great variation in activity between the so-called "good" and "bad" acids.

I felt, however, that these differences were points worth

following up, and I consequently investigated the effect of concentration and temperature on the rate of dissolution of iron in hydrochloric acid, the acid generally used for "pickling."

So far as I am aware, nothing has been published on this particular subject, although, as before stated, the amount of work done on the interaction of acids and metals has been very great. The results obtained in the various cases show how impossible it is to prophesy what will occur, even as regards the nature of the reaction, under any specified conditions; each case requires its own separate investigation. Thus sulphuric acid will only react with certain metals when hot and concentrated, the gaseous products of reaction being sulphurous anhydride. With other metals it will react in the cold, and at almost any strength, with evolution of hydrogen; but even with most of these latter metals it will give sulphurous acid when heated. With iron, whilst strongly active at certain concentrations, it becomes almost inactive at some definite intermediate concentration.

* * * * *

Effect of Concentration on the Activity.—My first experiments were done to find out the effect of the concentration of the acid on the rate of dissolution, and they consisted in noting the loss of weight suffered at ordinary temperature by pieces of iron of the same area in acids of various strengths.

The iron used was the black sheet of the galvaniser, that is, the iron as ready for the pickling bath after annealing. Each piece measured 5 cm. × 2½ cm., and was immersed standing on end in a small beaker containing 50 c.c. of hydrochloric acid, this quantity of acid being just sufficient to cover the metal. The loss of weight was determined after intervals of 1, 2, 3, &c. hours, the metal being in each case washed with water and alcohol before drying. The acid concentration in the several beakers varied from 25 to 358 grms. per litre.

The results obtained indicated that over this range of concentration the amount of action was not directly propor-

tional to the acidity of the solution. Thus, with a decrease of 10 per cent in the quantity of real acid present (from 310 grms. to 280 grms. per litre) the rate of solution fell to 50 per cent; that is, at the lower concentration it was only one-half its value at the higher. Although the results obtained could not be represented by a straight line, the values, however, seemed to follow a regular curve.

* * * * *

The foregoing experiments were all done with distilled hydrochloric acid practically free from impurity of any kind. In practice commercially pure acid is employed. Such acid must be free from arsenic, the presence of which is prejudicial during the pickling stage, apart from the trouble it causes later on in the galvanising bath. The effect produced when arsenic is present in small quantity is shown is Table IV. When larger quantities are present the iron becomes completely covered with a film of arsenic, which, at ordinary temperature, almost completely checks further action, even with the more concentrated acids.

TABLE IV

HCl, Grms. per Litre.	As_2O_3, Grms. per Litre.	$t°$ C.	C.c. Hydrogen evolved per 1 hour: Before addition of As_2O_3.	C.c. Hydrogen evolved per 1 hour: After addition.	Rising	In Minutes.
200	0.08	18	30	21	26	50
200	+0.16	18	26	19	26	60
216	0.04	18	12.6	5	..	..
180	0.08	54.5	304	120	248	40
180	0.08	55	370	156	345	60
180	0.08	61.5	522	220	470	40
216	0.04	56	425	305	..	..

* * * * *

TRANSACTIONS
of the
AMERICAN ELECTROCHEMICAL SOCIETY

Volume XXI

TWENTY-FIRST GENERAL MEETING
Boston, Mass., April 18, 19, 20, 1912

THE EFFECT OF VARIOUS SUBSTANCES ON THE RATE OF CORROSION OF IRON BY SULPHURIC ACID

By Oliver P. Watts

In Vol. 8 of the transactions of this society, C. F. Burgess called attention to the remarkable reduction in the corrosion of iron by sulphuric acid, brought about by the addition of a small amount of arsenious oxide to the acid. Later he explained the protective action as follows: "The explanation which has been offered for this phenomenon is that the iron receives, by contact with the solution, an extremely thin coat of arsenic which resists the action of the acid and protects the underlying metals." He also gave experimental proof that the iron was coated with arsenic.

* * * * *

On the theory that the protection of iron by a deposit of arsenic is due to the high overvoltage of hydrogen on the latter the action would be as follows: Iron dissolves and by so doing deposits arsenic upon the surface of the iron. Since the arsenic is deposited simultaneously with the dissolving of the iron, and only as a result of this dissolving, it is hardly possible that the iron should be perfectly covered by arsenic, but here and there holes will exist, allowing the iron to make contact with the electrolyte. Voltaic cells are thus formed. From the single potentials of iron and of arsenic, + 0.093 and — 0.550, these cells should have an electromotive force of 0.64 volts, and the corrosion of the

iron ought to be very vigorous. It is here that the overvoltage of hydrogen comes in play. The iron is anode and the arsenic cathode, and, just as in any other primary cell with sulphuric acid as electrolyte, hydrogen is deposited on the cathode. But when hydrogen is liberated on arsenic the potential of the latter is raised 0.39 volts higher than —0.277, the potential at which hydrogen is liberated on platinum-black. This would raise the potential of the arsenic to + 0.113 volts, or higher than the potential of the iron anode. This means that in our iron-arsenic cell there can be no visible evolution of hydrogen on the arsenic, for before this can occur the potential of the cathode has become equal to that of the anode, and corrosion of the iron ceases, in other words, this particular primary cell polarizes so badly that after a few seconds of action its electromotive force has fallen to zero.

* * * * *

DEPARTMENT OF THE INTERIOR
Franklin K. Lane, Secretary

BUREAU OF MINES
Van. H. Manning, Director

SUBSTITUTION OF NITRE CAKE FOR SULPHURIC ACID IN PICKLING STEEL

By E. E. Corbett, Chemical Engineer,
U. S. Bureau of Mines

Washington, D. C. October, 1918

PURPOSE AND SCOPE OF THE INVESTIGATION

As far as can be ascertained there have been few thorough-going endeavors to place on a broad working basis the pickling of steel for the removal of oxide scale. Such systematic researches as have been inaugurated and carried out have had as their object the establishment of a few simple methods applicable to a somewhat narrow procedure, of immediate bearing on a few specific problems,

and with apparent disregard of the fact that while various shapes and sizes require modification of apparatus and means of handling, the solution principles involved in the chemical processes are essentially the same. The various processes in use, therefore, are for the most part empirical and, indeed, somewhat inflexible to changes which tend materially to alter the mode of working the solutions.

* * * * *

INHIBITION, OR MODERATION OF METAL ATTACK

3. The activity of the acid, then, is directed to attacking selectively and dissolving the sound metal rather than the more resistant oxide or scale; but in well-regulated pickling practice the selective attack is limited, and, indeed, materially redirected and controlled by the use of bodies of a colloidal or semi-colloidal nature whose influence serves to protect the metal during scale removal. These bodies are for the most part of vegetable origin, and comprise various wood sugars and gums, and cereal starches, and intermediates occurring in commercial grain milling.

Specifically, the organic substances which have been successfully used for this purpose, in quantities sufficiently small as to give simply a distinct film to the surface of the bath under temperature conditions which moderate the charring of the inhibitor by hot acid solution, are listed below:

Molasses	Fermented yeast
Sugars	Spent tan-bark
Cornstarch	Bran
Peanut meal	Middlings
Quebracho fiber	Rye Flour

The inhibitor is usually prepared as a fermented swill or mash which is added to the bath at intervals determined by the rate at which its influence is destroyed by the chemical action of the acid.

Soap-bark and the various foam compounds in use are of an inhibitory nature. The last-named commercial preparations are essentially concentrated sulphite pulp ex-

tracts placed on the market as strong solutions or as powders incorporated with ground nitre cake and rock salt.

Tin and copper salts are representatives of the inorganic type of semi-colloidal inhibitors; but their action is of inferior consequence and their use restricted because of the cost of adding to the bath quantities sufficiently large to exercise a sensible influence, as well as their tendency, undesirable for most purposes, to plate out from solution upon the metallic surface.

The precise chemical mechanism of the inhibitor in solution has not been established; its beneficial action, however, both in limiting surface corrosion of metals, and in reducing the fume nuisance in pickling rooms is beyond question. It is believed, more commonly than logically, that a small quantity of one of these substances, thrown upon the surface of an active solution simply prevents the escape of disagreeable gases by blanketing the bath and absorbing the vapors—this, notwithstanding the difficulty of comprehending how hydrogen may be so blanketed, above a solution whose temperature rises close to the boiling point of water. It is a fact, however, that the surface tension of such a film does prevent to an appreciable degree, globules of acid solution from being forced almost explosively into the atmosphere surrounding the vats.

Nevertheless the main value of the inhibitor, from the pickling viewpoint, lies in the modifying action which it exerts on the tendency of the acid to attack the sound metal rather than the scale; and this moderating influence first shows itself in the comparatively lesser volume of non-condensible gas, chiefly hydrogen, which rises from the surface of the solution. The solution is no longer a system of acid in water, but acid in an emulsion of a starch or sugar with water; hence, in the different pickling medium the acid is carried by an organic vehicle in which its properties are necessarily modified. Similarly, the catalytic accelerating function of the ferrous sulphate in solution is neutralized; its dissociation value is reduced in the new medium, its sensible influence thus rendered comparatively inert.

PLAINTIFF'S EXHIBIT 12

SUMMARY OF ACID SHIPMENTS

Date	Oil Company	Gals.	Identification Per Cent	Inhibitor
2-11-32	Pure Oil Co.	500	15	2 gals. arsenic
3-11-32	" " "	500	15	2 " "
4- 5-32	" " "	500	15	4 " "
4-27-32	" " "	500	15	(4-5-32/4-27-32)
5- 5-32	" " "	500	15	12 gals. arsenic
5-21-32	" " "	500	15	(5/5/32-5/31/32)
5-25-32	" " "	500	15	
5-27-32	" " "	500	15	
5-28-32	" " "	500	15	
5-31-32	" " "	500	15	
6- 1-32	Columbia Oil & Gas Co.	80# 6 cbys.	15	44 gals. arsenic
6- 3-32	Pure Oil Co.	500	15	Pure Oil
6- 4-32	Columbia Oil & Gas Co.	53# 4 cbys.	15	28 gals. arsenic
6- 4-32	Lawrence Lee	500	15	Misc.
6- 7-32	Columbia Oil & Gas Co.	80# 6 cbys.	15	(6/1/32-6/30/32)
6- 9-32	Lawrence Lee	500	15	
6-11-32	Pure Oil Co.	500	15	
6-13-32	" " "	500	15	
6-15-32	" " "	500	15	
6-16-32	Chippewa Oil & Gas Co.	500	15	
6-17-32	Mt. Pleasant Oil & Gas Co.	500	15	
6-17-32	Pure Oil Co.	500	15	
6-16-32	W. L. McClanahan	500	15	
6-18-32	Lawrence Lee	500	15	
6-18-32	Talbot Oil Co.	500	15	
6-20-32	Pure Oil Co.	500	15	
6-20-32	Lawrence Lee	500	15	
6-20-32	The Gordon Oil Co.	500	15	
6-21-32	Pure Oil Co.	1000	15	
6-22-32	Stork Oil Co.	500	15	
6-22-32	Pure Oil Co.	1000	15	
6-23-32	Pure Oil Co.	1000	15	
6-24-32	Pure Oil Co.	1000	15	
6-25-32	Pure Oil Co.	1000	15	
6-25-32	Michigan Gas & Oil Co.	500	15	
6-27-32	Pure Oil Co.	1000	15	
6-28-32	Lupher Drilling Co.	25# 2 cbys.	15	
6-28-32	Ohio Produc. & Ref. Co.	500	15	
6-28-32	Pure Oil Co.	1000	15	
6-29-32	Lawrence Lee	1000	15	
6-30-32	Pure Oil Co.	1000	15	
6-30-32	Lawrence Lee	500	15	

Plaintiff's Exhibit 12

Date	Oil Company	Identification Gals.	Per Cent	Inhibitor
7- 1-32	Pure Oil Co.	1000	15	116 gals. arsenic
7- 5-32	" " "	1000	15	Pure Oil
7- 5-32	" " "	1000	15	44 gals. arsenic
7- 5-32	" " "	1000	15	Misc.
7- 5-32	Leonard Petroleum Co.	500	15	(7-1-32/7-25-32)
7- 5-32	Sias Oil Co.	500	15	
7- 6-32	Pure Oil Co.	1000	15	
7- 6-32	Stork Oil Co.	500	15	
7- 7-32	Pure Oil Co.	1000	15	
7- 7-32	" " "	1000	15	
7- 8-32	" " "	1000	15	
7- 8-32	Lawrence Lee	500	15	
7- 8-32	Chippewa Oil & Gas Co.	500	15	
7- 8-32	Ohio Prod. & Ref. Co.	500	15	
7- 8-32	Lawrence Lee	500	15	
7- 8-32	Pure Oil Co.	1000	15	
7-11-32	McClanahan, Well #10	500	15	
7-11-32	Pure Oil Co.	1000	15	
7-12-32	" " "	1000	15	
7-14-32	Ohio Prod. & Ref. Co.	500	15	
7-14-32	Pure Oil Co.	1000	15	
7-15-32	" " "	1000	15	
7-15-32	Talbot Oil Co.	500	15	
7-13-32	Leonard Petroleum Co.	500	15	
7-15-32	Pure Oil Co.	1000	15	
7-18-32	" " "	1000	15	
7-18-32	" " "	1000	15	
7-18-32	Chippewa Oil & Gas Co.	500	15	
7-19-32	Pure Oil Co.	1000	15	
7-19-32	Sias Oil Development Co.	500	15	
7-20-32	Pure Oil Co.	1000	15	
7-20-32	Sias Oil Co. (Brown A-1)	500	15	
7-21-32	Michigan Gas & Oil Co.	500	15	
7-21-32	Pure Oil Co.	1000	15	
7-22-32	" " "	1000	15	
7-22-32	Charlotte G. Marsh	500	15	
7-25-32	Gordon Oil Co.	500	15	
7-25-32	Pure Oil Co.	1000	15	
7-25-32	" " "	1000	15	
7-26-32	" " "	1000	15	
7-28-32	" " "	1000	15	
7-28-32	" " "	1000	15	
7-28-32	Columbia O. & G. Co. (Homick 1)	500	15	
7-29-32	C. W. Marsh	500	15	
7-29-32	Sias Oil Development Co.	500	15	
7-13-32	Pure Oil Co.	1000	15	
7-30-32	Gordon Oil Co.	500	15	
7-30-32	Pure Oil Co.	1000	15	
7-30-32	" " "	1000	15	
7-30-32	Columbia Oil & Gas Co.	500	15	
7-25-32	Pure Oil Co.	1000	15	

Plaintiff's Exhibit 12

Date	Oil Company	Identification Gals.	Per Cent	Inhibitor
8-1-32	Pure Oil Co.	1000	15	96 gals. arsenic Pure Oil
8-2-32	" " "	1000	15	
8-2-32	Reed Oil Co.	500	15	110 gals. arsenic Misc.
8-3-32	Producers Service Co.	500	15	
8-4-32	Talbot Oil Co.	500	15	(8/1/32-8/31/32)
8-4-32	Pure Oil Co.	1000	15	
8-5-32	" " "	1000	15	
8-5-32	Gordon Oil Co.	500	15	
8-8-32	Reed Oil Co.	500	15	
8-8-32	W. T. McIntosh	500	15	
8-8-32	Pure Oil Co.	1000	15	
8-8-32	" " "	1000	15	
8-9-32	" " "	1000	15	
8-9-32	Chippewa Oil Co. (2 loads)	1000	15	
8-9-32	Leonard Petroleum Co.	500	15	
8-9-32	W. T. McIntosh	500	15	
8-11-32	Mt. Pleas. O. & G. Co. (2 lds.)	1000	15	
8-11-32	Pure Oil Co.	1000	15	
8-12-32	" " "	1000	15	
8-12-32	Talbot Oil Co. (Adams #3)	500	15	
8-13-32	Sias Oil Co.	500	15	
8-13-32	Mt. Pleasant Oil & Gas Co.	1000	15	
8-15-32	Pure Oil Co.	1000	15	
8-15-32	" " "	1000	15	
8-16-32	Perkins Bros.	500	15	
8-16-32	Shoup Oil Co.	500	15	
8-16-32	Pure Oil Co.	1000	15	
8-17-32	" " "	1000	15	
8-17-32	Reed Oil Co.	500	15	
8-18-32	Michigan Gas & Oil Co.	1000	15	
8-18-32	Pure Oil Co.	1000	15	
8-19-32	Swastika Oil & Gas Co.	500	15	
8-19-32	Ohio Prod. & Ref. Co.	1000	15	
8-19-32	Pure Oil Co.	1000	15	
8-19-32	Simrall Refining Corp.	tank car	20° Be	
8-20-32	Gordon Oil Co.	1000	15	
8-20-32	" " " Sk #4	500	15	
8-20-32	Reed Oil Co.	1500	15	
8-20-32	Pure Oil Co.	1000	15	
8-22-32	" " "	1000	15	
8-23-32	The Wittmer Co.	1000	15	
8-24-32	Meridan Oil & Gas Co.	1000	15	
8-24-32	Pure Oil Co.	1000	15	
8-25-32	" " "	1000	15	
8-25-32	Sias Oil Development Co.	1000	15	
8-26-32	Mt. Pleasant Oil & Gas Co.	1000	15	
8-26-32	Swastika Oil Co.	1000	15	
8-26-32	Gordon Oil Co.	500	15	
8-27-32	Reed Oil Co.	1000	15	

Date	Oil Company	Identification Gals.	Identification Per Cent	Inhibitor
8-27-32	Henley Oil Co.	500	15	
8-29-32	Pure Oil Co.	1000	15	
8-29-32	Chippewa Oil & Gas Co.	5 cbys.	15	
8-30-32	Pure Oil Co.	1000	15	
8-30-32	" " "	1000	15	
8-30-32	Shoup Oil Co.	1000	15	
8-30-32	Ohio Prod. & Ref. Co.	1000	15	
8-31-32	Michigan Gas & Oil Co.........	1000	15	
8-31-32	Mammoth Pet. Co	1000	15	
8-31-32	Pure Oil Co.	1000	15	
8-31-32	" " "	1000	15	
8-31-32	The Stanolind Oil & Gas Co.	1000	15	
8-31-32	" " " " "	1000	15	
9- 2-32	Wittmer Co., McKenzie	1000		92 gal. arsenic
9- 2-32	Sias Oil Development Co.	1000		Pure Oil
9- 2-32	Pure Oil Co.	1000		36 gal. arsenic
9- 2-32	Stanolind Oil & Gas Co.	1000		Misc.
9- 2-32	Pure Oil Co.	1000		40 gal. mercaptan
9- 2-32	" " "	1000		base + 40# co
9- 3-32	" " "	1000		chloride—Pure
9- 4-32	" " "	1000		142 gal. mercaptan
9- 4-32	" " "	1000		base + 142# co
9- 6-32	Michigan Oil & Gas Co.	1000		chloride—Misc.
9- 6-32	Stanolind Oil & Gas Co.			56 gal. mercaptan
	(David #6)	1000		base + 56# co
9- 6-32	Ohio Prod. & Ref. Co.	1000		chloride (2 tank
9- 6-32	Braden & Saunders	1000		cars)
9- 7-32	Stanolind Oil & Gas Co.			(9-2-32/9-30-32)
	(David #3)	1000		
9- 6-32	Pure Oil Co.	1000		
9- 6-32	" " "	1000		
9- 3-32	Shoup Oil & Gas Co.	1000		
9- 7-32	" " " "	1000		
9- 7-32	Pure Oil Co.	1000		
9- 8-32	" " "	1000		
9- 8-32	Sias Oil Development Co.	1000		
9- 9-32	Stanolind Oil & Gas Co.			
	(Davis #6)	1000		
9- 9-32	Stanolind Oil & Gas Co.			
	(Davis #2)	1000		
9- 9-32	Pure Oil Co.	1000		
9-10-32	Simrall Refining Corp.	tank car		
9-10-32	Pure Oil Co.	1000		
9-11-32	" " "	1000		
9-12-32	Stanolind Oil & Gas Co.	500		
9-12-32	" " " "			
	(Davis #4)	1000		
9-12-32	Pure Oil Co.	1000		

		Identification		
Date	Oil Company	Gals.	Per Cent	Inhibitor
9-14-32	Bunks White et al.	1000		
9-13-32	The Wittmer Co. (Smith #2)	1000		
9-13-32	Hewitt Oil Co. (Hewitt #1)	1000		
9-13-32	Pure Oil Co.	1000		
	(Page missing from book—about 32,000 gals. of acid)			
9-26-32	Pure Oil Co.	1000		
9-27-32	Stanolind Oil Co. (McLauglin #7)	1000		
9-28-32	Stanolind Oil Co. (Ross #1)	1000		
9-27-32	Pure Oil Co.	1000		
9-28-32	" " "	1000		
9-28-32	" " "	1000		
9-30-32	Dow—Muskegon, Mich.	tank car		
9-29-32	Pure Oil Co.	1000		
9-29-32	Stanolind Gas & Oil Co.	1000		
9-29-32	Sias Oil Devel. Co. (Carpenter #2)	1000		
9-30-32	Reed Oil Co.	1000		
9-30-32	Pure Oil Co.	1000		
9-30-32	Thompson Oil Co. (Snyder Lease)	1000		
9-30-32	Stanolind Oil & Gas Co.	1000		
10- 1-32	Pure Oil Co.	1000		128 gals. arseni
10- 2-32	" " "	1000		acid
10- 3-32	Dow—Muskegon	1000		(10-1-32/10-31-3
10- 5-32	Pure Oil Co.	1000		
10- 6-32	Dow—Muskegon	tank car	15	
10- 5-32	Pure Oil Co.	1000		
10- 6-32	" " "	1000		
10- 7-32	" " "	1000		
10- 7-32	Gordon Oil Co. (Skinner #5-B)	1000		
10- 8-32	Dow—Muskegon	tank car	15	
10- 8-32	Pure Oil Co.	1000		
10- 8-32	" " "	1000		
10-11-32	" " "	1000		
10-12-32	Dow—No. Baltimore, Ohio	500		
10-13-32	Sias Oil Co. (Carpenter #3)	1000		
10-13-32	Pure Oil Co.	1000		
10-13-32	" " "	1000		
10-14-32	" " "	1000		
10-14-32	" " "	1000		
10-15-32	George Hemmerick	2		
10-15-32	Pure Oil Co.	1000		
10-15-32	" " "	1000		
10-18-32	Bowling Green, Ohio	1000		

Date	Oil Company	Identification Gals.	Per Cent	Inhibitor
10-16-32	Pure Oil Co.	1000		
10-16-32	" " "	1000		
10-17-32	" " "	1000		
10-20-32	Skinner #2	1000		
10-19-32	Pure Oil Co.	1000		
10-20-32	Pure Oil Co.	1000		
10-22-32	E. J. Henderson	1000		
10-21-32	Pure Oil Co.	1000		
10-21-32	" " "	1000		
10-23-32	" " "	1000		
10-23-32	" " "	1000		
10-24-32	Otway Well No. 1 (Porter Twnsp.)	1000		
10-24-32	Mellon & Pollock (Lynch #1)...	1000		
10-25-32	Pure Oil Co....................	1000		
10-25-32	Well #3 (B & O Lease)	500		
10-25-32	Well #3 (Hartman Lease, Ohio).	500		
10-20-32	F. Stiltzreid #1	1000		
10-25-32	Wittmer Co. (Smith #1)	1000		
10-26-32	Pure Oil Co.	1000		
10-26-32	" " "	1000		
10-27-32	" " "	1000		
10-27-32	" " "	1000		
10-31-32	Dow—No. Baltimore, Ohio.....	tank car	15	
10-29-32	Pure Oil Co.	1000		
10-30-32	" " "	1000		
10-31-32	Stepleton (J. S. Braden)	1000		
10-31-32	Pure Oil Co.	1000		
11- 1-32	Pure Oil Co.	1000		
11- 2-32	" " "	1000		
11- 3-32	" " "	1000		
11- 3-32	" " "	1000		
11- 4-32	" " "	1000		
11- 4-32	" " "	1000		
11- 5-32	" " "	1000		
11- 2-32	Sias Oil Devel. Co. (Carpenter #3)	500		
11- 4-32	Herring #1	1000		
11- 4-32	Ohio Prod. & Ref. Co. (Epple #2)	1000		
11- 4-32	Braden & Saunders (Stapleton #2)	1000		
11- 7-32	Mich. Oil & Gas Co.	1000		
11- 8-32	R. O. Malcolm	1000		
11- 9-32	J. S. Braden & Sanders	1000		
11-10-32	Chippewa Oil & Gas Co.	1000		

PLAINTIFF'S EXHIBIT 13

"SARNIA OIL AND GAS COMPANY, LIMITED
SARNIA, ONT.

June 13, 1932

"Dow Chemical Company,
Midland, Mich., U. S. A.
Gentlemen:

"We understand that you have developed a chemical that is having considerable success in Mt. Pleasant and Muskegon as to increasing the amount of production in the old oil wells there. As this territory here produces from the same formation we would be glad to receive any information you may have at this time and would like to work out some agreement for handling same, whereby it would be both profitable and agreeable to all concerned.

"Trusting to hear from you, we remain,

Very truly yours,
"Bert Wilson"

"THE OHIO PRODUCING & REFINING COMPANY
East Ohio Gas Building
Cleveland
June 17, 1932

"Dow Chemical Co.,
Midland, Michigan.
Gentlemen:

"It has come to my attention that certain tests are being made with muriatic acid in the oil wells in the Mt. Pleasant Field, with the result of increased production. Could you furnish me any information regarding these tests as to whether they are generally successful. I would also appreciate your estimate of the cost of the acid and the method of procedure in treating the wells.

Very truly yours,
"J. E. Schaefer"

Plaintiff's Exhibit 13

"PERKINS BROTHERS, INC.
GRAND RAPIDS, MICHIGAN

June 29, 1932.

"Dow Chemical Company,
Midland, Mich.
Gentlemen:

"We understand that you are manufacturing an acid which is claimed to increase the production of oil wells, after same has dropped to a low figure.

"We have an interest in several wells in Michigan, which at present are producing from the Traverse and Dundee formations.

"We are also interested in a number of wells in Kentucky, part of which are producing from sandstone formation, and the others from a lime, or coniferous formation, which, as we understand it is similar, if not identical with our Michigan Traverse and Dundee.

"We should appreciate hearing from you as to the amount of acid necessary, and the cost of same, and whether you treat the wells yourselves, or if this can be done by the caretaker on a lease.

"We should also like to have you advise what success you have met with so far.

Yours truly,
"Perkins Brothers, Inc.
By G. W. Perkins, Jr.
Per E. J. R."

"Madisonville, Kentucky, July 6, 1932

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"Attached hereto is a clipping from the Louisville Times which appeared last night. It is of particular interest to me because I own two leases in this county upon which are thirteen wells eight years old.

"The production is found at approximately 500′ in the 'Finnie sandstone' (Tradewater formation—Pottsville age) of Coal Measure age (Allegheny-Pennsylvania). Casinghead elevations do not show any particular structure and indications point to a lenticular condition of the sand. The wells started off with an average flush production of 50 barrels per day but have now declined to less than one barrel per day each. Not much gas was present with the oil. The sand varies in thickness from five to twenty feet.

"Since the production has now declined to the point where they must either be abandoned or means taken to improve the production I am earnestly interested in any process which holds some promise of increasing the production.

"I would appreciate having more complete information about your process, the cost of treating wells, the royalty for using the process, the success you have had with it, etc. I shall be glad to experiment with the process under your direction in any manner your experience may dictate.

Yours very truly,
"William E. Schwartz"

(Newspaper Clipping)

"CHEMICAL FIRM FINDS NEW WELL TREATMENT

"Midland, Mich., July 5, 1932—Dow Chemical Company has discovered a new treatment for oil wells, which, it claims, has increased production in the Midland-Isabella fields since its introduction.

"By injecting acid into oil-bearing sand, chemists for the company claim, they have increased the porosity of the strata."

Plaintiff's Exhibit 13

"STANOLIND OIL AND GAS COMPANY
Tulsa, Oklahoma

July 12, 1932

"Dow Chemical Company
Midland, Michigan
Gentlemen:

"We understand that your Company has been furnishing an acid for use in the Mt. Pleasant Oil Field for reaction on the lime producing formation for increasing oil recoveries.

"Will you please advise us just what this acid is and quote our Purchasing Department prices on same f.o.b. McCamey, Texas.

Yours very truly,
"G. S. Bays"

"AMERICAN PIPE & STEEL CORPORATION, LTD.
Alhambra, California

July 15, 1932

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"From an article published in the local newspaper in Pawtuckett, R. I., we learn that you have a chemical treatment for oil wells. The writer being interested in quite a few oil properties would appreciate having information on it.

Yours very truly,
"Jack Lane"

"THE NATIONAL REFINING COMPANY
Cleveland, Ohio, U. S. A.

July 15, 1932

"Dow Chemical Company
Midland, Mich.
Gentlemen:

"We understand that you have perfected a chemical powder for use in crude oil wells for increasing production and that it has been tried out successfully in some of the oil fields in Michigan.

"We would like to have any information you can give us on the subject, and would appreciate your advice as soon as possible.

"I might add that we have asked the Grasselli Chemical Company in Cleveland if they know anything about such a chemical but they state they have not been advised of anything along these lines.

"Possibly the information that has reached us is not based on facts. At any rate, we would like to have you advise us.

Scientific Refining
"The National Refining Co.
"S. A. White
"Purchasing Agent"

"INDIAN TERRITORY ILLUMINATING OIL COMPANY AND SUBSIDIARY COMPANIES
Oklahoma City, Oklahoma

July 25, 1932.

"The Dow Chemical Co.,
Midland, Michigan.
Gentlemen:

"We understand that producers in the Midland field are using a considerable quantity of acid after these wells are completed. We are wondering whether or not the use of this acid might be warranted in other areas of the

United States, particularly with reference to some areas in Oklahoma. In order to reach any conclusion, we would ask that you furnish us the analysis and manner of handling Dowell Acid; the approximate quantities required; and the results of applying acid.

"Thanking you in advance for your kindness in this matter, I am

Yours very truly,
C. O. Rison
"Gen. Supt., Prod. Dept."

"UNION OIL COMPANY OF CALIFORNIA
Santa Fe Springs, California
August 10, 1932

"Dow Chemical Company
Midland, Michigan
Gentlemen:

"I today came upon an advertisement in the 'Oil Weekly' for Equipment for the Field, in this same advertisement was an article mentioning a recent development of an Acid Solution to clean out old wells and stimulate production. The trade name of this product being 'Dowell.'

"I will appreciate receiving complete information regarding this product as I am very interested.

"Thank you in advance for this courtesy.

Very truly yours,
F. W. Lake
"General Superintendent"

"EMPIRE OIL & REFINING CO.
El Dorado, Kansas

August 19, 1932.

"The Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"It is reported your firm has a specially prepared hydrochloric acid solution for treating limestone oil wells.

"Will you kindly supply us with data relating to results obtained in your area by treating with this solution, the action of the solution on pipe, method of application, prices, etc.

"Yours very truly,
"Geo. F. Berry, Jr.
"Resident Geologist"

"GULF PRODUCTION COMPANY
Fort Worth, Texas

August 30, 1932

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"I have read with interest the account in the Oil Weekly of August 29th of your treatment by means of acid of a well in the Dundee limestone in Midland County, Michigan.

"Will you kindly let me have as much detail as consistent concerning this process? We have quite a number of wells in limestone pay formations, chiefly of Permian age but of very similar chemical characteristics to the ordovician, and therefore, such treatment as mentioned in the Midland County well is of interest to us.

Yours very truly,
"H. A. Melat."

"SHAPPELL OIL COMPANY
Wichita Falls, Texas
August 31, 1932.

"Dow Chemical Co.,
Midland, Michigan.
Gentlemen:

"Please send me any literature or information you have on the product known as 'Dowell' such as you used in the treating of the Walter L. McClanahan Inc., Schaffer No. 1 Well, in Midland County, Greendale, Michigan.

"Conditions here are such that we need something of this nature very badly. If it is successful I will be glad to represent you in this area.

"I have been a representative of Petroleum Treating Compounds here for three years and know personally every producer who might be in the market for such a product as yours.

"Hoping to hear from you in the near future and trusting that we may be able to work out something to our mutual advantage, I am,

"Yours very truly,
(Signed) "Dale Shappell"

"HERCULES POWDER COMPANY
Wilmington, Delaware
September 2, 1932.

"The Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"We have noted your advertisements regarding a method of treating oil wells with an acid to increase the flow of the well.

"We would appreciate it very much if you would give us details regarding this method of treating oil wells to increase their production.

"Very truly yours,
J. Barab, Manager
"Service Division."

"CONTINENTAL OIL COMPANY
Los Angeles
September 12, 1932

"Dow Chemical Company
Midland, Michigan
Gentlemen:

"I read with interest an account in the Oil Weekly, August 29, issue, Page #57, describing results of acid treatment on a producing well. I would appreciate having more information on this experiment; also whether the chemical used is recommended only for limestone formation or could be used in California Fields.

Very truly yours,
"M. N. Phillips"

"CENTRAL UTILITIES CORPORATION
New York, N. Y.
September 12, 1932

"Michigan Oil Journal
Blanchard, Mich.
Gentlemen: Att. Mr W. D. Garvin

"In the issue of your paper—September 6, 1932, I have read an article headed 'Dowell Acid Saves Semi Wildcat Well.' In said article it says, 'the treating of the well by the Dow process, however, and its intendant flow of crude, awakened operators to the full realization of the value of the Dowell acid in 'doster wells.'

"Will you be kind enough to let me know something about this process and how it is used.

"Thanking you in advance for any information you can give me, I remain

Yours very truly,
L. Adam
H."

"CRYSTAL OIL REFINING CORPORATION
Shreveport, La.
September 12th, 1932.

"Dow Chemical Co.
Midland, Mich.
Gentlemen:

"We are considerably interested in an article that appeared recently in The Oil Weekly in which it stated that a new chemical discovered by your company had been used with success in increasing the production from a pumping well near Midland, Mich.

"It will be appreciated if you will let us hear from you describing the use of this chemical, and the price of same, as we have some settled production in this territory that we could probably help by its use.

Yours very truly,
"A. J. Ahlum
"Assistant Secretary"

"JO H. CABLE
Petroleum Engineer
Wichita Falls, Texas
September 12, 1932.

"Dow Chemical Co.,
Midland, Michigan.
Gentlemen:

"Mr. Frank Maire of Lima, Ohio, has told me of your acid treatment of lime wells, and I am very much interested in this development.

"Kindly send me all available information and advise me cost of chemical for 600 to 1100' wells delivered to Wichita Falls, method of application, recommendations, etc.

"After making some tests on my own production, I would be interested in handling the acid treatment in this area if a mutually agreeable arrangement can be made.

Yours very truly,
"Jo. H. Cable"

Plaintiff's Exhibit 3

"R. H. BROWNLEE LABORATORY
Research and Consultation
Pittsburgh, Pa.

Sept. 17, 1932.

"Dow Chemical Company,
Midland, Michigan.
Dear Sirs:

"A client of ours is desirous of trying Acid treatment to increase the flow of oil in some of his wells, and I understand you make and sell an inhibitor to prevent action of the acid upon the pipe, etc.

"If my information is correct, will you kindly advise prices on this material and full particulars as to its use, quantities required, etc. Also send C.O.D., a few pounds for laboratory use in tests.

"If there is any literature available, such as journal articles, patents, etc., shall appreciate having reference thereto.

Very truly yours,
"R. H. Brownlee Laboratory.
"R. H. Brownlee"

"THE CALIFORNIA COMPANY
Dallas, Texas

September 20, 1932

"Dow Chemical Company
Midland, Michigan
Gentlemen:

"We have noted with interest a news item appearing in the Oil Weekly of August 29th, concerning the use of an acid to increase the production in a limestone well drilled by a Mr. Walter L. McClanahan in Midland County.

"Our Company is a producer in West Texas in which territory practically all the production is had in limestones and where, in wells that show for small producers, it is a practice to shoot the producing horizon with nitro-glycerine in order to improve the production.

"If details concerning the treating of the above mentioned well are available we would greatly appreciate it if you would furnish them to us in order that we may study this method in connection with our own operations.

Yours very truly,

The California Company

"By R. H. Morrison"

"UNION CRUDE OIL CORPORATION

Oklahoma City, Oklahoma

September 23, 1932

"Dow Chemical Company,

Midland, Michigan.

Gentlemen:

"I am informed that in the Mt. Pleasant field of Michigan that often times when there is no amount of fluid in their lime holes that they are using an acid to open the pores of the formation.

"We are drilling a well in the Zwolle, La. field and while we have a slight show of oil (about a barrel a day) we are unable to get any oil to speak of out of the hole. This formation being a very hard chalk, we thought perhaps a treatment of acid might tend to open the formation and we might get some kind of a small well. Our hole is perfectly dry and we have approximately 450 feet of 4⅞" liner in the hole. The show that we do have is coming from some place in this 450 feet of liner but we don't know exactly where as there was no perceptable change in the formation at that depth.

"Would thank you very much to give us information as soon as possible on what kind of acid to use and the closest point to Zwolle, La., the same might be shipped from (Zwolle is 80 miles south of Shreveport).

"We are at present matking (making) about 20 feet of additional hole which will still leave us in chalk formation.

"Would appreciate a reply by return mail.

Yours very truly,

"(Signature illegible)"

AIR MAIL

"CAPITAL DRILLING, INC.
Columbus, Ohio
September 26, 1932

"The Dow Chemical, Inc.
Midland, Michigan
Gentlemen:

"We should like some information on the acid treatment for oil wells in the Niagara Lime which you people furnish.

"We have a number of wells which we are getting ready for some such treatment and other wells which will need this same treatment in the near future.

"We are interested in getting full details about this acid treatment: would it be necessary to pull the 2" tubing; how do you put the acid in the well; how much material would it take for each well, do you deliver and instruct the operations of this treatment?.

"What would our price be on 500-gallon lot?

"Would appreciate an immediate reply as we are rearranging our work in the oil fields at the present time to make some such test and would be willing to try your product on one of the wells if your proposition is in line.

Yours very truly,
Capital Drilling, Inc.
"C. W. Blacksten
Secy-Treas."

"LAUGHNER OIL AND GAS CO.
South Heights, Pa.
September 27, 1932

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"We noticed a news article in the Oil City Derrick about the success that is being had by the use of an acid manufactured by your Company for the purpose of accelerating the production of oil and gas from wells.

"We would be pleased to have a descriptive circular dwelling upon the nature of this acid, together with its method of use—Also prices.

Very truly yours,
Laughner Oil & Gas Company,
"By John C. Bander"

"BRADFORD MOTOR WORKS
Bradford, Pa.

Sept. 29th, 1932.

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"We have learned that you manufacture a compound which has been used successfully in cleaning out old wells in the Michigan oil fields.

"Some of our customers in this field are interested, and we should like to have you inform us as to this material and what it is expected to accomplish.

Very truly yours,
Bradford Motor Works,
"S. H. Johnson
Secretary."

"ANACONDA KEVIN OIL COMPANY
312 East Park Avenue
Phone 633
Anaconda, Montana.

Oct. 1st, 1932.

"Dow Chemical Co.,
Midland, Michigan.
Gentlemen:—

"Notice write up in the Montana Oil & Gas Journal, regarding Acid treatment for Oil Wells.

"Kindly advise price? Has anybody used this in Montana?

"Any information you will give will be appreciated.

Yours very truly,
"F. M. Davidson"

"UNITED STATES
"DEPARTMENT OF COMMERCE
BUREAU OF MINES
Box 1207
Shreveport, La.

October 8, 1932

"The Dow Chemical Co.
Midland, Michigan
Gentlemen:

"In the August 29, 1932, issue of the Oil Weekly, page 57, I notice an account of the increasing the oil production from a limestone reservoir, by the use of acid. I was very interested in this article and am wondering if you have any literature regarding the procedure and the kind of acid and amounts used in these experiments.

"Any literature or material you have would be appreciated.

Very truly yours,
"R. E. Heithecker
"Petroleum Engineer"

"C. E. DAUGHERTY & CO.
Owensboro, Ky.
Norman, Oklahoma, October 10, 1932

"Dow Chemical Company
Midland, Michigan.
Gentlemen:

"My attention has been called to the success of acid treatment of wells in the Central Michigan field as recorded in the Oil Weekly. Prof. H. C. George, Director of the School of Petroleum Engineering of the University of Oklahoma, has asked that I investigate the process and prepare a paper covering it.

"I have been unable to find references on this subject in the files of the department. I desire rather complete information as regards to; the condition of the wells calling for treatment, the chemical functions and the mechanical

operations of the process itself, production decline data after treatment, and cost of treatment.

"H. A. Barrett of Glasgow, Ky. first called my attention to such treatment and asked if I thought the treatment applicable to wells in the LeGrand pool of Hart County, Ky. At that time Mr. Barrett and associates were planning to treat a few wells in that district. If possible, I would like to have information regarding the results of the treatment of wells in that and/or any other district.

"At the present time I am on leave at the University to finish my undergraduate work in petroleum engineering. In February my work will be completed and I will return to my position as engineer for C. E. Daugherty of Owensboro, Ky. My employer has production in most of the lime areas through Kentucky and some in southeastern Indiana. If the process seems applicable to the declining production in any of these areas I will recommend it to my employer.

"Realizing that the data I request is rather voluminous I thank you in advance.

"Very truly yours,
"W. B. Heck, Jr."

"447 Chautauqua Ave.,
Norman, Oklahoma."

"JOHN A. KAY
Petroleum Geologist
Wichita Falls, Texas

October 14, 1932

"Dow Chemical Company
Midland, Michigan
Gentlemen:

"The current issue of the Oil Weekly carried a news item from Mount Pleasant, Michigan, in which there was a brief account of the results of treating the producing horizons in oil wells with acids. The article stated that your company had introduced this idea to the oil fields.

"Since this news appeared I have had a number of inquiries from clients asking for information on this process.

Some of these men are anxious to try the acid treatment on their own properties.

"If your company is distributing these acids and has information as to costs, methods of application or other pertinent details, I would be pleased to receive this information from you.

Yours very truly,
"John A. Kay"

"CAMBRIDGE GAS COMPANY
and
"HARVARD GAS COMPANY
Charleston, W. Va.
October 17, 1932

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"Attention: Research Department.

"It has come to our attention that in the Saginaw oil field in Michigan you have used an effective chemical to dissolve lime which does not attack the pipe lines. We are much interested in securing details from you to see if this process would be at all applicable in the Berea Sand of this section.

"Our Berea ranges from 20′ to 26′ and of course the porosity varies greatly in different sections. While we have never made any chemical tests of our sands to determine the lime content, often in drilling sand we find lenticular strata which to the eye appears to be limestone. The more porous the formation the greater the amount of stone, which seems to be lime, ordinarily speaking.

"We operate about twenty thousand acres and have approximately eighty oil and gas wells, all in the Berea sand. Most of the wells were shot with thirty quarts of nitro-glycerin from 2′ to 12′ in the sand.

* * * * * *"

"AMORY PETROLEUM CORPORATION
Amory, Miss.

November 4, 1932.

"The Dow Chemical Company,
Midland, Michigan.
Gentlemen:

"We are just in receipt of a letter from the State Geologist of the State of Michigan, giving us various information with regard to the use of hydrochloric acid in increasing open hole flows of both oil and gas wells, and in this letter they refer us to your company.

"The Amory Petroleum Corporation owns what is known as the Amory Gas field. We have four producing wells, producing from what we believe to be Bargor formation. Two of the wells produce approximately 7,000,000 cubic feet of gas per day, from a depth of 2400 feet, and two other wells only produce from 200,000 to 400,000 within a quarter mile from the two larger wells. Hydrochloric acid tests on the producing sands show considerable lime reaction, and our Carter No. 2 well, which produces only 200,000 cubic feet of gas per day, is located only 590 feet north of our No. 1 well, producing 7,000,000. The Rock Pressure of the area is approximately 400 pounds.

• • • • • •

"We have been advised that your company were sending out representatives thruout the country on this new form of testing, and we are wondering whether or not you are in position to quote us prices regarding the total cost of making such tests on our wells. If you are a representative who is working close to this territory, we believe it would be to your interest to have him come into Amory, and go over the matter with us, as there is a large field for your operations here.

Very truly yours,
"F. P. Borden
"Secretary"

"LONE STAR GAS COMPANY
Dallas, Texas
November 5, 1932

"Dow Chemical Co.,
919 Jefferson Ave.,
Midland, Michigan.
Gentlemen:

"We have learned from periodicals and other sources of an acid treatment of oil wells which has been developed apparently to a greater degree of efficiency and perfection in Michigan than in other fields where experiments are now being started by various companies.

"We are very much interested in the proposition and our information is that your company participated in the early development of the proposition in the Michigan territory. I believe, also, there have been some other companies that have since brought out some chemical compositions which are supposed to produce the same results as the composition that you developed in the Michigan field, and perhaps in other fields. As we are very much interested in the entire matter, I am writing to you for such information as you can give us with regard to the methods used, also with regard to whether or not the chemical composition which you developed is marketed in this part of the country, and also whether you have found that different chemical compositions are more adaptable to different geological formations. I find that quite a few companies have started making some tests in this section of the country, but so far as we can learn they are without the exact information which seems to be necessary for an intelligent consideration of the entire matter, and as we are completely without technical information with regard to the whole matter it has occurred to me to write to you in the hope that you can at least give us a lead on some information that might be helpful; of course, with the idea that we would show our appreciation for such information as you give us in the way of reciprocity if such a thing is feasible. We have no information whether you are doing anything towards selling

your product in this part of the United States or cooperating with producers in the way of giving them aid or information, such as I believe you did in the Michigan field.

"We would be very glad indeed to hear from you in regard to the matter.

Yours very truly,
"F. L. Chase
R."

"TEXAS PACIFIC COAL AND OIL COMPANY
Fort Worth, Texas
November 8, 1932

Dow Chemical Company
Midland, Michigan
Gentlemen:

"We understand that you manufacture an inhibitor for the use of hydrochloric acid in oil wells, and that you also undertake the treatment of oil wells.

"Will you kindly advise your terms and prices for such work and also if you are selling the inhibitor separately from the acid, and what your charges are for this material?

Very truly yours,
Texas Pacific Coal and Oil Company
"By E. R. Lederer"

"BROWN TOOL COMPANY (Inc.)
Breckenridge, Texas
November 15, 1932

"Dow Chemical Co.
Midland, Michigan.
Gentlemen:

"I understand that you hold a patent on the treatment of oil wells by the introduction of acid as being practiced here by the Independent Torpedo Co. Having been located in this field since 1919, I am interested in anything that increases the flow of wells, and am conducting a series of laboratory tests in preparation to developing a suitable

process, if I can not make suitable arrangements with someone already owning the rights on such process. I would be very glad to have a letter from you together with a copy of your patent, stating whether you would be interested in a royalty contract, and quoting me on Muriatic Acid, giving gravity of same.

"In your reply, whether favorable to a royalty contract or not, I ask you kindly that you do not fail to give me the number and date of your patent.

"Relating to the possibility of a royalty contract, it will be of interest to you to know that the writer has been a member of the American Society of Mechanical Engineers for a good many years and for several years was a member of the American Society of Mining and Metallurgy, as well as holding a full membership in the Society of American Military Engineers.

"The Brown Tool Company, due to its charter, could not be interested in this proposition, but arrangements will be made that the fulfillment of any contract would be guaranteed by them. I own 97% of the stock of the company.

"Hoping to have an early reply, I am

Yours very truly,

"C. H. Brown

"(Pres. Brown Tool Co.)"

"SHELL PETROLEUM CORPORATION

St. Louis, Mo.

November 28, 1932

"Dow Chemical Company,

Midland, Michigan.

Gentlemen:

"We would be interested in receiving such information as you are prepared to give regarding the use of chemicals for cleaning oil wells of calcareous material, and for solving paraffin problems where these have developed in casing or tubing of wells or in the bore hole.

Yours very truly,

"Shell Petroleum Corporation.

"By G. S. Rollin

Vice-President Production.

"SIMMS OIL COMPANY
Dallas, Texas

Nov. 29th, 1932

"Dowell Incorporated,
Midland, Mich.
Gentlemen:

"I noticed in November 28th issue of the 'Oil Weekly' that you have formed your Company for the purpose of manufacturing and sale of a special acid limestone solvent.

"Wish you would furnish us with the detail of this process and what your price for the acid is, say in 1000-gallon lots.

"We have quite a number of lime wells in Texas that might respond to this kind of treatment and for this reason are interested in this process and cost.

Yours very truly,
"Blaine Johnston
"General Superintendent"

"TEXOMA NATURAL GAS COMPANY
Amarillo, Texas

November 30, 1932

"Dowell, Incorporated
Midland, Michigan.
Gentlemen:

"We have been reading with interest your acid treatment of small or abandoned lime oil wells and also in some cases the treatment of lime gas wells. We are not now in the market for any such treatment, but would be pleased if you could furnish us with data of the procedure and technique of your treatment, especially pertaining to lime gas wells.

Yours very truly,
"Ogden S. Jones"

Plaintiff's Exhibit 13

"HUMBLE OIL & REFINING COMPANY
Houston, Texas.

December 1, 1932

"Dow Chemical Company
919 Jefferson Avenue
Midland, Michigan.
Gentlemen:

"We understand you are marketing a chemical compound for use in oil well cleaning work. We would appreciate complete information from you in regard to the manner in which this product is used, and the type of the acid in the compound, and the strength of the solution. We desire this information so that we may determine, should we use this product, the effect it would have on the metal equipment we have in our wells. It is our understanding that this chemical is diluted to some extent before being used in the wells.

"We would also like to have you quote us prices on this product in lots of 300 gallons up to tank cars, f.o.b. Breckenridge, Texas.

"Will you kindly let us hear from you promptly?

Yours very truly,

"Humble Oil & Refining Company
"By J. M. Sitler
General Purchasing Agent"
"J.A.R."

"J AND J PETROLEUM CORP., INC.
Longview, Texas
December 10, 1932

"Sales Department
Dow Chemical Company
Midland, Michigan
Gentlemen:

"We are operating in many sections of the East Texas oil fields and we are coming in contact with many producers who are beginning to be troubled with parafine. Our familiarity with the Michigan field brings to mind that this is one of the troubles that developed in that field, and that your company has developed a chemical for the treatment of wells so affected.

"Do you have a representative in East Texas? If not, do you desire to make such a connection? If so, we would be very glad to represent you and to stock a supply of your chemical and to give it proper advertising and distribution.

"May we hear from you in the near future?

Yours very truly,
"Foley Operating Co.
"By: John Foley
Pres."

"UNITED STATES
"DEPARTMENT OF COMMERCE
"BUREAU OF MINES
December 12, 1932

"Dowell Incorporated,
Midland, Michigan.
Gentlemen:

"I am interested in your chemical processes to increase oil production and wish you will kindly send me your booklet entitled 'How to Increase Oil Production.'

Very truly yours,
"H. C. Miller
"Senior Petroleum Engineer"

"TEXAS GULF COAST PRODUCTION COMPANY .
25 Broadway, New York
December 12th, 1932

"Dowell, Inc.,
Midland, Michigan.
Gentlemen:

"Your 'ad' in the Oil & Gas Journal of Tulsa, Oklahoma is interesting and if you have booklets and other data for distribution will be glad to have it mailed to me at the Hotel Portland, Washington, D. C.

Very truly yours,
"James B. Hammond.
"President."

"W. C. McBRIDE, INC.
"THE SILURIAN OIL COMPANY
1226 Olive Street
St. Louis
December 13, 1932

"Dow Chemical Co.,
Midland, Michigan.
Gentlemen:

"I have recently read in the Petroleum World an interesting account of the results obtained by chemical treatment of old wells under your Patent #1877504.

"We are the owners of considerable production from old producing wells in Illinois and Cushing, Oklahoma, and would appreciate your giving us further information in regard to this matter, especially the approximate cost of treating wells under this process and also the results obtained. Many of our wells are producing from lime horizons.

"Yours very truly,
"C. F. Buchner
"Vice-President."

"THE EMPIRE COMPANIES
Bartlesville, Okla.
December 14, 1932.

"Mr. C. E. Clason,
Lassen Hotel,
Wichita, Kansas.
Dear Sir:

"Confirming our conversation of yesterday when you were in this office, with reference to acid treatment of wells for this Company:

"As I understand it, the Dow Chemical Company desires to treat some wells in the Mid-Continent field to determine the benefits which might be expected from this treatment. The Empire Oil and Refining Company has several wells in Butler County, Kansas, producing from lime formation and it is proposed that we permit the Dow Chemical Company to select ten wells for treatment. The Dow Chemical Company will furnish all chemicals, delivered at the well, and will supervise placing them in the wells. The Empire will furnish labor for pulling rods and other miscellaneous work necessary in placing the chemicals in the wells and will pay the Dow Chemical Company only in the following manner: A joint test will be made to determine the oil production of each well before treatment and also a joint test of the oil production of these wells will be made after treatment, and the Dow Chemical Company will receive their payment of $300.00 per well out of one-half of seven-eighths of the increased production only if, as and when produced and marketed by the Empire. In the event that treatment does not increase production as indicated by these joint tests, the Empire will be under no obligation to the Dow Chemical Company.

"Should you desire to enter into an agreement of this kind, please advise and we will have contract prepared and furnish you with more detailed information on our wells.

Very truly yours,
"M. R. Shaffer,
"General Superintendent,
Oil Production."

"J. S. COSDEN, INC.
Okemah, Oklahoma
December 14, 1932.

"Dow Chemical Company,
Midland, Michigan.
Gentlemen:—

"We would like to have you inform us further, than the write-up in the 'Oil Weekly,' as to the manner of treating oil formations with acid. We have a small producer in the Seminole field (Wilcox Sand), as well as some others, that we might figure on your working over.

"After we hear from you, we shall then make a more definite plan.

Yours very truly,
"J. S. Cosden, Inc. of Okla.
"By: M. M. Miller."

"B. V. von Vitanyi
Oberingenieur

"Dusseldorf-OK.,
Niersstrasse 1
December 15, 1932

"Messrs. Dowell Incorporated
Midland, Michigan.
Dear Sirs,

"From your advertisement in 'The Oil Weekly' I read about the development of a new chemical process for the purpose of increasing oil-production.

"Being the representative of the Ingersoll-Rand Co., 11 Broadway, New York, for Germany I am greatly interested in the new process developed by you in view of my close connections to the German oil fields around Hannover.

"Please forward your booklet describing the new method and its adaptability to different oil formations. In case you think the method applicable to European oil fields I certainly would like to join your sales-organization in some form.

"Referring you to Messrs. Ingersoll-Rand Co. for any information you may desire about my person I hope to have an early answer from you.

Yours very truly,
"B. V. Vitanyi"

"R. B. LAING
1130 North Cheyenne
Tulsa, Oklahoma.

December 20th, 1932.

"The Dow Chemical Co.
Midland, Mich.
Dear Sirs:

"A friend of mine who is a representative of the Shell Co. and returned from Michigan recently, informed me that you had a chemical for treating Oil Wells with a lime formation, thereby increasing the production, and which I understand in (is) not injurious to casing or tools. It occurred to me that you might want some one to represent you in Oklahoma or Kansas and push the sale of your chemical. I have been in the oil business a number of years, and know many of the heads of the large companies and am conversant with oil operations. The oil business at the present is in rather a chaotic condition, and some operators may argue that they do not want to increase their production, but they will if it does not cost too much to do so. Should you require a representative, I shall be glad to receive a reply from you, and I can supply you with satisfactory references as to my stability, and honesty &c.

Yours very truly
"R. B. Laing."

"GYPSY OIL COMPANY
Tulsa, Oklahoma.

January 19, 1933.

"Dowell Incorporated,
Midland, Mich.
Gentlemen:

"We have noted with interest the result of acid treatment as applied to oil wells, and the rapid spread of this method of treatment throughout the Mid-Continent area.

"We have in mind the possibility of treating certain of our wells in the State of Kansas, and in this connection would like to know whether or not your company will be prepared to service wells in that area within the near future. If you have a specific plan formulated, we would like to know the date on which your service will be available.

Very truly yours,
"S. G. Sanderson
General Superintendent"

PLAINTIFF'S EXHIBIT 14

"The Midland Republican
Midland, Michigan, Thursday,
June 9, 1932

"TREAT WELLS BY DOW PROCESS
TO JUMP PRODUCTION

"New Acid Injection Said to
Have Increased Stripper
Flow as Much as
10 Times

"Contracting Work in Midland Field

"A new process of injecting acid into oil wells, which is supposed to increase the porosity of the oil bearing sand and result in a heavier flow of oil from wells which have nearly stopped producing, was announced this week by Dow officials. Oil men are showing a keen interest in the process, which they believe would revive old wells, especially since it has been said to produce as much as ten times the original flow in one stripper. The process in no way affects the quality of the oil.

"The idea is an outgrowth of a process developed for increasing the flow of brine wells. Dow Chemical Co. is contracting to treat wells, but does not take any responsibility for results accomplished. The services of an engineer are to be made available for the new work. Robert Quinlan has been placed in active charge of the work through the sales department. The acid used is trademarked Dowell and the process covered by applications for patents.

"Since the commercial use of the acid was decided upon

the GLeeP firm has been the first to contract for its use. According to Laurence W. Lee, an official, one well is being treated while six more are to be given acid in an attempt to bolster production.

"The treatment has been used on a number of wells in the Midland-Isabella field and found satisfactory according to those in active charge.

"Enthusiastic reception by oil men, lease holders and land owners has been given wherever the process and its working have become known. In it, they see possibilities for getting many times the present production from wells, which have practically ceased to be of any value. This may mean the reworking of dozens of sites in the field and stir a new line of activity."

PLAINTIFF'S EXHIBIT 19

INVOICE

HALLIBURTON OIL WELL CEMENTING CO.
Duncan, Oklahoma

March 11, 1935

CHARGE TO C. F. Hilligoss, Box 812, Wichita, Kansas. 1005 A T

Well No. 2-A Farm Isern Sec. 12 Twp. 20 Range 11-w
Depth 3290 Size Casing $2\frac{1}{2}''$ Tub. Used 1000 Gal. Acid.

To furnishing acidizing equipment for acidizing above well, 1000 gal. acid used. $225.00

INVOICE No. A-2

PLAINTIFF'S EXHIBIT 20

INVOICE

HALLIBURTON OIL WELL CEMENTING CO.
Duncan, Oklahoma

May 25, 1935

CHARGE TO	Oko Oil & Gas Company Iola, Kansas	1008 A T

Well No. 4 Farm Pinion Sec. 27 Twp. 23 Range 13-E
Depth 1713 Size Casing 6⅝" Used 1000 Gal. Acid

To furnishing acidizing equipment for acidizing above well, 1000 gal. acid used. $186.00

Invoice No. A-4

PLAINTIFF'S EXHIBIT 21

INVOICE

HALLIBURTON OIL WELL CEMENTING CO.
Duncan, Oklahoma

May 25, 1935

CHARGE TO	Oko Oil & Gas Company Iola, Kansas.	1009 A T

Well No. 4 Farm Pinson Sec. 27 Twp. 22 Range 13-E
Depth 1713 Size Casing 6⅝" Used 1000 Gal. Acid

To furnishing acidizing equipment for acidizing above well, 1000 Gal. acid used. $186.00

Invoice No. A-7

PLAINTIFF'S EXHIBIT 23

PURCHASE ORDER

Erle P. Halliburton, Inc. No. 1234
810 South Spring Street
Los Angeles, Cal.
To Dowell Incorp.,
Shreveport, La.

Please deliver to Bair #2 5-21-34

Quantity	Article	Price
1500 gal.	acid job	$350.00
	Less 10%	35.
		$315.00

Less 2% for cash—
Erle P. Halliburton, Inc.
By Jack Halliburton

PLAINTIFF'S EXHIBIT 26

PURCHASE ORDER

Erle P. Halliburton, Inc. No. 4618
District Office Mansfield, La. Date Oct. 24, 1934
To Dowell Incorp. Address Shreveport, La.
Please deliver below order to Burkett #3

Quantity	Size	Description
1	1500 Gal.	Acid Job

Dowell
Rec'd Oct. 29, 1934
Tulsa, Okla.
Noted by MW.
(Signed) Jack Halliburton

PLAINTIFF'S EXHIBIT 27

No. 37 Dowell Incorporated Order 2081

BULK MATERIAL SALES RECEIPT

District Louisiana Station Many Date Nov. 9, 1934
Received of Dowell Incorporated the following materials in good order on Customer's Order No. 4581 dated Nov. 9, 1934. Burkett #1.

Quantity	Item	Unit Price	Total Price
1000 gal.	Dowel X	$.25	$250.00

Plus Transportation Charges None
Plus Extra for None Containers at None each ——

$250.00

(signed) Chas A. Prince
For Dowell Incorporated

Customer Billing Address: Erle P. Halliburton, Inc. 810 S. Spring St., Los Angeles.
By (Signed) Jack Halliburton

PLAINTIFF'S EXHIBIT 31

This Agreement, made and entered into this 15th day of March, 1934, March 19, A.M., 9/03, by and between Dowell Incorporated, a corporation organized under the laws of Michigan, with its principal office at Midland, Michigan, hereinafter referred to as Seller, and Steen Drilling, Inc., located at 1418 Esperson, Houston, Tex., hereinafter referred to as Buyer, Witnesseth:

Whereas, The Dow Chemical Company is the owner of certain United States Letters Patent for processes to be applied to a producing oil or other deep well to increase the production thereof; said Patents being Numbers 1,325,293; 1,476,747; 1,856,912, 1,877,504; 1,911,446; 1,916,122; and

Whereas, The Dow Chemical Company has also developed other processes and products for the treatment of deep wells for which United States Letters Patent have been applied; and

Whereas, Seller has obtained from The Dow Chemical Company a license to practice the inventions disclosed in said Letters Patent above listed, and has obtained an agreement for licenses to practice the inventions useful in the treatment of wells on which Letters Patent may be obtained by The Dow Chemical Company; and

Whereas, Seller is equipped to supply and transport products developed by The Dow Chemical Company for increasing the production of deep wells, and to supervise and provide facilities for the treatment of deep wells with such products: Now Therefore

Said Seller agrees to sell to said Buyer and said Buyer agrees to purchase from said Seller sufficient Dowell-X and/or other materials for the treatment (within the period hereinafter specified) of not less than 2 wells nor more than 2 wells owned, operated or leased by the Buyer and located in certain counties and states as follows: Louisiana, Sabine Parish.

Said Buyer agrees that within thirty days from the

date hereof it will have not less than 2 wells in readiness for treatment and shall, during each thirty days period thereafter until the contract has been completed, have in readiness for treatment not less than .... additional wells.

Seller reserves the right to refuse to treat any well designated by the Buyer which in the opinion of Seller will not satisfactorily respond to treatment by Dowell-X.

Quantity: Seller's representative in charge shall determine the exact quantities of Dowell-X and/or other materials required for such treatment: Provided, however, that the amount shall not be more than 1,500 gallons nor less than 500 gallons per well: And provided further, that if Buyer shall so direct in writing the maximum gallonage herein specified shall be used.

Price: The price for each well to be treated within a twenty mile radius of Seller's nearest distribution station shall be as follows.

Distribution Station	State	Price
Many	La.	$800.00

For wells located beyond such a radius an additional charge of no cents per mile will be made from the distribution station to the well and return.

In case of imposition of additional Federal or State Taxes of any kind, the Seller shall add such additional costs to the price specified herein.

If Buyer shall have over .... wells treated hereunder and shall duly pay Seller's invoices therefor, it shall be entitled to a rebate of .... per cent.

Terms: Net cash ten days.

Package: In tanks or containers to be furnished by the Seller and equipped with apparatus for administering treatment.

Delivery: Buyer shall furnish Seller with a written order for each well to be treated, specifying the time of delivery and giving Seller reasonable notice thereof. Buyer agrees to have the well in readiness for treatment at the time thus specified, and in event Seller shall be delayed in administering such treatment by reason of any act or omis-

sion on Buyer's part, Buyer shall pay to Seller an additional compensation of $5 for each hour, or fraction thereof, that Seller is delayed in administering treatment. Seller shall furnish its own equipment for transporting and applying the Dowell-X and other materials to the well and shall furnish one employee to make said treatment, and the Buyer shall provide all other necessary help. If the highway conditions prevent Seller from reaching the well with its regular motor trucks, then Buyer shall furnish the necessary form of transportation without charge to the Seller.

Seller shall not be held responsible for any default occasioned by war, fire, strike, accident, civil or military authority, or other contingencies beyond its control.

In view of the impossibility of obtaining accurate knowledge with reference to thickness and variations in the underlying rock structures and the uncertainties of determining the exact conditions of any well before and after treatment, Seller makes no guaranty concerning effectiveness of the product or results of its application; nor shall Seller be liable for any damages, consequential or otherwise, which may be occasioned by any such treatment. No verbal agreement or understanding with Seller's representatives not written herein shall affect or vary this contract as herein expressed and which covers all matters agreed upon with reference thereto. This contract shall not be binding upon Seller until approved by its Home Office at Midland, Michigan.

Executed in duplicate and declared binding upon the parties hereto, their successors and assigns.

Dowell Incorporated
By C. A. Prince, Sales Engineer
Seller

Steen Drilling, Inc., Buyer
By Jack Halliburton.

Approved at Midland, Michigan:
Dowell Incorporated
By Sherman W. Putnam.
Secretary.

PLAINTIFF'S EXHIBIT 34

This Agreement, made and entered into this 20th day of April, 1934, by and between Dowell, Incorporated, a corporation organized under the laws of Michigan, with its principal office at Midland, Michigan, hereinafter referred to as Seller, and Steen Drilling Incorporated or Erle P. Halliburton, Incorporated, located at 1418 Esperson Building, Houston, Texas, hereinafter referred to as Buyer, Witnesseth:

Whereas, The Dow Chemical Company is the owner of certain United States Letters Patent for processes to be applied to a producing oil or other deep well to increase the production thereof; said Patents being Numbers 1,325,293; 1,476,747; 1,856,912; 1,877,504; 1,911,446; 1,916,122; and

Whereas, The Dow Chemical Company has also developed other processes and products for the treatment of deep wells for which United States Letters Patent have been applied; and

Whereas, Seller has obtained from The Dow Chemical Company a license to practice the inventions disclosed in said Letters Patent above listed, and has obtained an agreement for licenses to practice the inventions useful in the treatment of wells on which Letters Patent may be obtained by The Dow Chemical Company; and

Whereas, Seller is equipped to supply and transport products developed by The Dow Chemical Company for increasing the production of deep wells, and to supervise and provide facilities for the treatment of deep wells with such products; Now Therefore

Said Seller agrees to sell to said Buyer and said Buyer agrees to purchase from said Seller sufficient Dowell X and/or other materials for the treatment within 12 months, of 10 or more wells owned, operated or leased by the Buyer and located in certain states as follows, such wells to comprise said Buyer's complete and entire acidization requirements during such period and so located: Louisiana, Oklahoma, Kansas, Texas, New Mexico.

Seller reserves the right to refuse to treat any well designated by the Buyer which in the opinion of Seller will not satisfactorily respond to treatment.

Quantity: Seller's representative in charge shall determine the exact quantities of Dowell X and other materials required for such treatment: Provided, however, that the amount shall not be more than 1500 gallons nor less than 500 gallons per well: And provided further, that if Buyer shall so direct in writing the maximum gallonage herein specified shall be used.

Price: The price for each well to be treated shall be as follows: 10% Discount.

BASE PRICE

1000 gallon—oil well treatment	$250.00
1000 gallon—gas well treatment	285.00
500 gallon—oil well treatment	190.00
Two 500 gallon—oil well treatments, same pool, same day (same or separate customers) each	160.00
Additional Dowell X, same well, same day, add per gallon	.20
All above prices are for Dowell X. If Dowell XX is required, add per gal.	.02

For treatments requiring other special products, such as Dowell XF, an additional charge will be made as arranged for in advance of treatment.

Mileage: All prices are based on well location within a reasonable distance from Seller's nearest established treating station. For wells located beyond such a reasonable distance, an additional charge will be made as mutually agreed upon in advance of the treatment.

The price in this contract is based upon Seller's present costs of labor, raw materials, transportation, and manufacture. If any of these costs increase materially from causes beyond Seller's control, Seller shall have the right to make a corresponding increase in the price in this contract, upon giving the Buyer ten days' written notice. If Buyer is un-

willing to accept such increase, it shall have the right to terminate this contract upon giving Seller written notice within ten days after receipt of Seller's notice of increase in price.

In case of imposition of additional Federal or State Taxes of any kind, the Seller shall add such additional costs to the price specified herein.

Terms: 2% cash discount for payment on or before 20th of month following date of invoice. All accounts unpaid sixty days after date of invoice subject to interest charge of 6% per annum from date of invoice.

Package: In tanks or containers to be furnished by the Seller and equipped with apparatus for administering treatment.

Delivery: Buyer shall furnish Seller with a written order for each well to be treated, specifying the time of delivery and giving Seller reasonable notice thereof. Buyer agrees to have the well in readiness for treatment at the time thus specified, and in event Seller shall be delayed in administering such treatment by reason of any act or omission on Buyer's part, Buyer shall pay to Seller an additional compensation of $5 for each hour, or fraction thereof, that Seller is delayed in administering treatment. Seller shall furnish its own equipment for transporting and applying the Dowell X and other materials to the well and shall furnish one employee to make said treatment, and the Buyer shall provide all other necessary help. If the highway conditions prevent Seller from reaching the well with its regular motor trucks, then Buyer shall furnish the necessary form of transportation without charge to the Seller.

Seller shall not be held responsible for any default occasioned by war, fire, strike, accident, civil or military authority, or other contingencies beyond its control.

In view of the impossibility of obtaining accurate knowledge with reference to thickness and variations in the underlying rock structures and the uncertainties of determining the exact conditions of any well before and after treatment, Seller makes no guaranty concerning effectiveness of the product or results of its application; nor shall

Seller be liable for any damages, consequential or otherwise, which may be occasioned by any such treatment. No verbal agreement or understanding with Seller's representatives not written herein shall affect or vary this contract as herein expressed and which covers all matters agreed upon with reference thereto. This contract shall not be binding upon Seller until approved by its Home Office at Midland, Michigan, or its Branch Office at Tulsa, Oklahoma.

Executed in duplicate and declared binding upon the parties hereto, their successors and assigns.

Dowell Incorporated
By R. D. Shaw, Sales Engineer
Seller

Steen Drilling, Inc., or Erle P. Halliburton, Inc., Buyer.
By Jack Halliburton.

Approved at Tulsa, Oklahoma
Dowell Incorporated
By Crawford,
Mgr. Tulsa Branch, Sec'y. Treas.

PLAINTIFF'S EXHIBIT 38

STEEN DRILLING, INC. No. 8029
Duncan, Okla.

Purchase Order Date 3-15-34
Issued to Dowell Inc.
Shreveport, La.
To be delivered to Burkett #1

Quantity	Size	Description	Charge
1500 gal.		acid shot	$602

(Signed) Jack Halliburton

PLAINTIFF'S EXHIBIT 40

STEEN DRILLING, INC. No. 8030
Duncan, Okla.

Purchase Order Date 3-17-34
Issued to Dowell Inc.
Shreveport, La.
To be delivered to Bair #1

Quantity	Size	Description	Charge
1500 gal.		acid job	$601

(Signed) Jack Halliburton

PLAINTIFF'S EXHIBIT 43

STEEN DRILLING, INC. No. 8571
Duncan, Okla.

Purchase Order Date: 4-20-34
Issued to Dowell Incorp.
Shreveport, La. & Tulsa, Okla.
To be delivered to Raymond #1

Quantity	Size	Description	Charge
1500 gal.		Acid Job	$604

(Signed) Jack Halliburton

PLAINTIFF'S EXHIBIT 46

PURCHASE ORDER No. 1201

Erle P. Halliburton, Inc.
810 South Spring Street
Los Angeles, Cal.

To Dowell Incorporated
835 Kennedy Bldg., Tulsa, Okla.

Please deliver to Raymond #1 5-9-34

Quantity	Article	Price
2000 gal.	acid job	$450.00
	Less 10%	45.00
	net	405.00

Also cash discount of 2%.

Erle P. Halliburton, Inc.
By Jack Halliburton

PLAINTIFF'S EXHIBIT 52

Dowell Incorporated

TREATMENT RECEIPT

Order 1128

District Louisiana Station Many Date July 10, 1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. 5796 Dated 7-10-34 Dowell Treatment No. 444

Location Sec. 21-9-13 Owner Erle P. Halliburton Inc.

County Sabine State La. Well Name G. I. Paul #2

Billing Address c/o Jack Halliburton, Mansfield Hotel, Mansfield

Single Treatment or Yearly Contract Yearly Base Price $450 Discount 10%

Using 2000 gallons Dowell X and the following additional materials, if any, at prices listed

Extra for mileage, if any None

Extra for time loss, if any None

Total billing price $405.00 Less 2% cash discount if paid on or before August 11, 1934.

Customer Erle P. Halliburton Inc.
By (Signed) F. A. Rymer

(Signed) Chas. A. Prince
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 54

Dowell Incorporated

TREATMENT RECEIPT

Order 1187

District Oklahoma Station Seminole Date 7/24 1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. Phone Dated 7-23-34 Dowell Treatment No. 435

Location 9-7-4 Owner Erle P. Halliburton

County Pottawatomie State Oklahoma Well Name Pearson #3.

Billing Address Erle P. Halliburton, Maud, Oklahoma.

Single Treatment or Yearly Contract Single Base Price $650.00 Discount 10%

Using 3000 gallons Dowell X and the following additional materials, if any, at prices listed

2000 additional gallons @ 20c per gallon total $400.00

Extra for mileage, if any None

Extra for time loss, if any None

Total billing price $585.00, less 2% cash discount if paid on or before 20th of following month, 1934.

Customer Erle P. Halliburton
By Paul Halliburton

(Signed) R. F. Copus
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 57

Dowell Incorporated

TREATMENT RECEIPT

Order 1367

District La. Station Many Date 8-15-1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. 5754 Dated 8-15-34 Dowell Treatment No. 464

Location Sec. 15-9-13 Owner Erle P. Halliburton Inc.

County Sabine State La. Well Name Jackson #1

Billing Address Mansfield Hotel, Mansfield, La.

Single Treatment or Yearly Contract Yearly Base Price $250.00 Discount 10%

Using 1000 gallons Dowell X and the following additional materials, if any, at prices listed

1000 gallons Dowell X @ .20 per gallon $200.00

Extra for mileage, if any None

Extra for time loss, if any None

Total Billing Price $405.00, less 2% cash discount if paid on or before Sept. 20, 1934.

Customer Erle P. Halliburton, Inc.
By Jack Halliburton

(Signed) C. A. Prince
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 59

Dowell Incorporated
TREATMENT RECEIPT

Order 1674

District Louisiana Station Many Date Sept. 16, 1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. 9510 Dated 9-16-34 Dowell Treatment No. 505

Location Sec. 9-9-13 Owner Steen Drilling Inc.

County Sabine State La. Well Name A. J. Burkett #B1

Billing address 1418 Esperson Bldg., Houston, Texas.

Single Treatment or yearly contract yearly Base Price $350.00. Discount 10%.

Using 1500 Gallons Dowell X and the following additional materials, if any, at prices listed

Extra for mileage, if any None. Same company as Erle P. Halliburton Inc. Discount as same C. A. P.

Extra for time loss, if any None

Total Billing Price $315.00, Less 2% cash discount if paid on or before Oct. 20, 1934.

Customer Steen Drilling Inc.
By Jack Halliburton

(Signed) Chas. A. Prince
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 60

STEEN DRILLING, INC.
Duncan, Okla.

Purchase Order No. 9510
Issued to Dowell Incorporated Date 9-16-34
at Shreveport, La.
To be delivered to Burkett #B-1

Quantity	Size	Description	Amount	Charge
1500 gal.		Acid job	$315.00	$608

Less 2% for cash
(Signed) Jack Halliburton

PLAINTIFF'S EXHIBIT 62

Dowell Incorporated
Treatment Receipt Order 1967

District Louisiana Station Many Date Oct. 24, 1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. 4618 Dated 10-24-34 Dowell Treatment No. 523

Location Sec. 16-9-13 Owner Erle P. Halliburton Inc.

County Sabine State La. Well Name Burkett #3

Billing Address Mansfield, La., Hotel Mansfield, c/o Jack Halliburton

Single Treatment or Yearly Contract yearly Base Price $350.00 Discount 10%

Using 1000 gallons Dowell X and the following additional materials, if any, at prices listed

Extra for mileage, if any None

Extra for time loss, if any None

Total billing price $315.00 Less 2% cash discount if paid on or before Nov. 25, 1934.

Customer Erle P. Halliburton, Inc.
By F. A. Rymer

(Signed) Chas. A. Prince
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 64

Dowell Incorporated
Treatment Receipt Order 2104

District Louisiana Station Many Date Nov. 14, 1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. 4588 Dated Nov. 14, 1934 Dowell Treatment No. 535

Location Sec. Owner Erle P. Halliburton Inc.

County Sabine State La. Well Name Burkett #3

Billing Address Mansfield Hotel, Mansfield, La., c/o Jack Halliburton

Single treatment or yearly contract Yearly Base Price $450.00 Discount 10%

Using 2000 gallons Dowell X and the following additional materials, if any, at prices listed:
1000 at $.20 per gal.

Extra for mileage, if any none

Extra for time loss, if any none

Total billing price $405.00 Less 2% cash discount if paid on or before Dec. 20, 1934.

Customer Erle P. Halliburton Inc.
By Jack Halliburton

(Signed) Chas. A. Prince
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 66

Dowell Incorporated
Treatment Receipt

District Louisiana Station Many Date Dec. 19, 1934

Received of Dowell Incorporated, one oil/gas well treatment as follows:

On Customer's Order No. Telephone Dated Dec. 28, 1934.
Dowell Treatment No. 553

Location Sec. Owner Erle P. Halliburton

County Sabine State La. Well Name Barr #1

Billing Address Los Angeles, Calif., 815 Spring St.

Single Treatment or Yearly Contract Yearly Base Price $250.00 Discount 10%

Using 1000 gallons Dowell X and the following additional materials, if any, at prices listed

Extra for mileage, if any 0

Extra for time loss, if any 0

Total billing price $225.00 Less 2% cash discount if paid on or before Jan. 25, 1935.

Customer Erle P. Halliburton
By F. A. Rymer

(Signed) Chas. Prince
Dowell Treating Engineer

PLAINTIFF'S EXHIBIT 93

OIL CITY DERRICK

Thursday, October 10, 1895

A GREAT DISCOVERY

How the Production of Lima Oil Wells May Be Increased Without Shooting.

Lima, O., Oct. 9.—A new method of increasing the output of oil wells, based on chemical action, has been brought to light, which will have a great influence on the production of oil in the future. It will be of special value to the oil producer. It has already been tested, and has been proven a success.

This method is based on the fact that the oil bearing rock is lime formation, which is readily dissolved, or disintegrated by acids. Hydro-chloric acid is the one preferably used, as it changes 40 per cent by weight of the rock it dissolves, into carbonic acid gas, and the remaining 60 per cent into chloride of calcium. The chloride of calcium is more soluble in water than common table salt, while the carbonic acid gas is readily bound by the water when under pressure.

The oil-bearing rock is made up of hard particles cemented together. This cement is more readily acted upon by the acid than the hard particles, therefore when the acid is pressed back into the rock, it dissolves out that part which binds the rock together; for this reason, when ten or twenty tons of rock are dissolved out, and removed from a well, hundreds of tons of rock have been disintegrated, and new channels formed, causing the rock to give up its oil, which cannot be done in any other way known.

The acid naturally follows the loose rock containing the oil, and wherever it touches the rock it leaves its track of carbonic acid gas and chloride of calcium. The chloride of calcium is taken up by the water, and a channel, or opening remains leading back to the well. By this means oil meas-

ures or pockets can be reached which ordinarily would not be found, crevices or openings in the rock are enlarged; horizontal channels are cut to greater distances, the acid seeking out the porous rock that contains the oil, making it possible for one well to drain a scope of territory that by the usual method would take many wells.

Large quantities of water are used with the acid so that the acid may be carried long distances, and the water be present to take up the rock when it is made soluble. Also the water being under great pressure, binds the carbonic acid gas in large quantities, and again liberates the gas to rush back through the long channels leading to the well, when the pressure is removed by starting the pump. Also by this method pockets or reservoirs can be excavated at the bottom of a well to receive and hold the oil that drains to it, so that small head wells would have to be pumped only once a week, or so, that ordinarily have to be pumped once or twice a day.

At first thought the average mind would conclude that if 10 or 20 tons of acid were put into an oil well it would not be neutralized by the lime rock, and that when re-tubed the tubing and cups would be eaten by the acid. On the contrary, it has been proven by actual tests in a large way that when the acid is pressed back into the rock it is thoroughly used up by uniting with the rock and forming new compounds, carbonic acid gas and chloride of calcium, which are harmless. The chloride of calcium is taken up by the water and is pumped from the well without in any way harming the working barrel or valves, in fact, the acid does its work so completely that not even traces of acid can be found in the water by the most delicate tests known to chemistry. From 50 to 100 barrels of acid are usually used in one well.

In applying this process the tubing and rods are removed from the well, and a one-inch tubing is substituted, reaching down at least to below the casing and usually to the top of the oil bearing rock. This one-inch tubing is coated so that the acid will not affect it, and is termed the

acid pipe. To introduce the acid and do no injury to the casing it is necessary to pack the well off below the casing, which can be done with an ordinary packer; however, in practice, where oil is accessible, it is used to serve as a packer. Some three barrels of acid are put into the well through the acid pipe, then the well is filled outside of the acid pipe and inside of the casing with crude oil, thus, in effect, packing the well off just above the oil bearing rock.

In the average small well the oil bearing rock is usually close, the channels leading to the well are small and the oil that reaches the well is forced into it by the rock pressure, which is generally from a small pressure to 400 or 500 pounds per square inch. In introducing the acid into such rock to open the channels it is necessary to use sufficient pressure to overcome the rock pressure and to carry the acid back into the rock. The pressure necessary for this purpose is had from the hydrostatic column of acid in the acid pipe leading from the top to the bottom of the well, which exerts a pressure of from 700 to 800 pounds per square inch on the rock.

It is sometimes found, where the rock is close and the channels small, that additional pressure to that had from the hydrostatic column has to be employed, then a pump is used to press the acid back into the rock. In such wells, the acid will be driven into the rock very slowly at first, possibly not faster than a barrel per hour; however, as the acid begins to open up the channels, it is received more freely, and at the finish, it will take the acid and water at the rate of six or eight barrels per hour.

Two months ago, a practical test of this process was made on a well on the Crossely farm, owned by the Ohio Oil Company, near Lima, Ohio. There were 65 barrels of acid used in the well on the Crossley farm. The channels in the oil rock in this well, were so tight that even with a pressure of between eight and nine hundred pounds per square inch, the rock would take barely a barrel of acid and water per hour. However, as the acid began to perform its work, the channels in the rock were gradually increased so

that at the finish the rock would readily take up six barrels per hour.

Since doctored, this well has been pumped some 40 days. The oil was increased 300 per cent, and the gas over 400 per cent. The increase has been permanent as the well is holding up.

When it is taken into consideration that with one ton of acid, one ton of rock can be removed, and that the acid will naturally follow the loose, porous rock, and the low price of acid, one can see how easily and cheaply channels can be excavated in the oil bearing rock, extending long distances from an oil well. Any practical oil producer will quickly appreciate the value of such excavated channels.

While this process may seem very simple after the above explanation, yet it has required considerable ingenuity and skill, and a practical knowledge of oil wells, as well as chemical facts to develop the thought, and bring it to its present perfection so that now an oil well can as readily be doctored with acid as it can be torpedoed, and results obtained that cannot be hoped for from the use of glycerine. This method was originated and developed by J. W. Van Dyke, of Lima, superintendent of the Solar refinery, and Herman Frasch, of Cleveland, who are the owners of the patents covering the same. P. B. C.

PLAINTIFF'S EXHIBIT 94

DOWELL INCORPORATED STATISTICS
(November 10, 1932 to 1940 inclusive)

	1932	1933	1934	1935	1936	1937	1938	1939	1940
Personnel[x]	21	33	60	58	90	187	164	209	229
Treating Stations	7	6	11	10	14	22	23	28	26
Pump Trucks	8	11	16	21	37	51	50	53	56
Compressor Trucks	0	0	2	2	2	2	5	4	5
Tank Transports	0	1	8	10	7	23	23	23	23
Tank Trailers	0	3	6	13	29	67	71	71	73
Pick-Ups and Passenger Cars	0	0	1	18	30	74	79	100	112
Well Treatments	59	1121	1988	2144	3057	4764	3850	4241	5522
Number of States in which Dowell operated	3	7	9	11	12	12	14	15	16
	Mich.	M-	M-	M-	M-	M-	M-	M-	M-
	Ohio	O-	O-	O-	O-	O-	O-	O-	O-
	Ky.	K-	K-	K-	K-	K-	K-	K-	K-
		Kan.	K-	K-	K-	K-	K-	K-	K-
		La.	L-	L-	L-	L-	L-	L-	L-
		Okla.	O-	O-	O-	O-	O-	O-	O-
		Tex.	T-	T-	T-	T-	T-	T-	T-
			Ill.	I-	I-	I-	I-	I-	I-
			Mont.	M-	M-	M-	M-	M-	M-
					N.Mex.	N.M.-	N.M.-	N.M.-	N.M.-
					Wyo. W.	W-	W-	W-	W-
						Calif.	C-	C-	C-
							Ind.	I-	I-
							Ark.	A-	A-
								Mo.	M-
									Nebr.

[x]Does not include part time employees

PLAINTIFF'S EXHIBIT 142

Index Card, Carnegie Library, Pittsburgh, Pa.

"Oil City Derrick (Daily), January 14, 1876-1903, September 1, 1909-1929, 1876-1929.

* * * * *

"The most valuable existing record of development of the petroleum industry in the United States. Special attention to markets, field operations, and production."

PLAINTIFF'S EXHIBIT 143

OIL CITY DERRICK, MONDAY MORNING, OCTOBER 28, 1895

OIL NEWS

THE MONTPELIER FIELD

A Decline in the Volume of Active Operations —Price Report of Producers' Committee

Operators are making many comments on the proposed method of "doctoring" wells with hydrochloric acid instead of shooting them with nitro-glycerine, and a large number of them would like to see an experiment with the acid tried in the Hoosier field.

PLAINTIFF'S EXHIBIT 144

OIL CITY DERRICK, SATURDAY MORNING, NOVEMBER 9, 1895

OIL NEWS

ANOTHER ACID TEST

The New Process Tried on a Well in the Findlay District—Field Notes

Findlay, O., Nov. 7.—(Special.)—Another test of the Van Dyke-Frasch method of treating wells with hydrochloric acid has been made, this time on a small well in the Findlay filed. The test was a marked success. The well upon which the experiment was made is owned by the Ohio Oil Company, and is situated on the J. W. Taylor farm, about four miles north of Findlay.

One hundred and eighty carboys of the acid were used in the well, which, before the test, made about 5 bbls. of oil daily. The experiment was made last week, since which time the well has been steadily producing 35 bbls. of oil every day.

PLAINTIFF'S EXHIBIT 145

OIL CITY DERRICK, WEDNESDAY MORNING, JANUARY 15, 1896

OIL NEWS

ACID TESTS

Several additional tests of the method of treating wells with acid have been made recently. A car load of the acid was placed in the Ohio Oil Company's No. 1 well on the Mary Richard farm, located one-half a mile east and one-half mile north of Prairie Depot, O. This well, which is about five years old, was increased from 4 bbls. to 11 by the treatment.

A second test in the Findlay field has not proven a success. The Ohio Oil Company's No. 2 well on the Thos. Cusac farm, located three miles northwest of Findlay, was treated with the acid a short time ago. This well is about nine years old. Its production of about 4 bbls. daily, was not changed by the treatment.

A well owned by A. A. Scott & Co. on the Arnett farm, located about four miles east and one mile south of St. Mary's, O., was also treated. This well was increased from about 11 to 16 bbls.

A well owned by A. A. Scott & Co. on the Metz farm, located three miles east and one-half mile south of Glynwood, O., was treated, and its production was increased from 2½ bbls. to about 11 bbls.

PLAINTIFF'S EXHIBIT 146

OIL CITY DERRICK, THURSDAY MORNING, FEBRUARY 20, 1896

OIL NEWS

ACID TESTS

An Interesting Topic of Discussion Among Oil Producers—Satisfactory Results

Lima, O., Feb. 17—(Special.)—The Van Dyke-Frasch method of treating wells with hydrochloric acid is generally becoming a very interesting topic for discussion among the oil men of Northwestern Ohio and Indiana. The tests that have already been made in different parts of the field have in most cases resulted very satisfactorily. Other tests are being made as rapidly as possible, and the great discovery will undoubtedly soon take rank as one of the most important branches of the oil industry.

The experiments so far have all been made on wells that were small at the outset, or what is worse, played out wells and even dry holes. It would be of great interest to the trade to witness a test made upon a well of fair calibre in a good field.

The well on the Taylor farm, north of Findlay, which was treated last October, has given the best results of any test yet made. It is estimated that the increased production of this well since it was treated, amounts in value to about $3,500. It is interesting to note that a well, situated on a farm just across the road from the Taylor farm, was given a good shot with glycerine at about the same time that the Taylor well was treated with acid, and it is reported that this well has not as yet paid for the shot in increased production. The total cost of the acid treatment is at present about $300 for each well, and it is quite probable that these figures will be considerably reduced when the process has received general use.

Plaintiff's Exhibit 146

The well on the Mary Richard farm, near Prairie Depot, which was increased by the acid treatment from a daily production of 3 bbls. to 12 bbls., is now making about 15 bbls. daily.

The well on the Cusac farm, northwest of Findlay, the production of which was not increased by the acid treatment, will be torpedoed soon. The effects of a shot and the acid ought surely to bring forth an increase in production, provided there is any more oil to be found.

A. A. Scott & Co.'s well on the Arnett farm, east of St. Marys, which was increased from 11 to 16 bbls., has been given a shot and has declined to 8 bbls.

Neely & Co.'s No. 1 well on the Neely & Co. farm, section 16 St. Marys township, Auglaize County, has been treated with acid and its daily production increased from 7 to 17 bbls. thereby.

A. A. Scott & Co.'s No. 1 well on the Longsworth farm, section 8, Washington township, Auglaize county, has also been treated. This well was, and is yet, a dry hole.

A. A. Scott & Co.'s No. 1 well on the Metz farm, near Glynwood, which was increased from 2½ to 11 bbls., is now making between 25 and 30 bbls. daily.

A. A. Scott & Co.'s No. 4 well on the Presser farm, a short distance west of the Metz farm, was increased by the acid process from 7½ to 20 bbls.

Other tests of the acid process are now being made, the results of which will be presented to the trade through the Derrick as soon as possible. P.B.C.

PLAINTIFF'S EXHIBIT 147

OIL CITY DERRICK, SATURDAY MORNING, FEBRUARY 22, 1896

OIL NEWS

THE FINDLAY FIELD

Very Little Work in Progress—Operations Widely Scattered

The Ohio Oil Co. has shot its No. 2 well on the Cusac farm, in Liberty township. This is the well that was unsuccessfully treated with hydrochloric acid a short time ago. It is said that the shot has bettered it considerably, although just how much cannot be estimated at present.

PLAINTIFF'S EXHIBIT 148

OIL CITY DERRICK, THURSDAY MORNING, MARCH 26, 1896

OIL NEWS

PRODUCTIONS INCREASED

Favorable Results Gained by Treating Wells With Hydrochloric Acid

Lima, O., March 24.—(Special.)—The more tests that are made of the system of treating wells with hydrochloric acid for the purpose of increasing the oil production

through the spring up of the rock fissures by the chemical process of disintegration, the more evident does it appear that the method is a success beyond the experimental stage.

That by this process production can be increased where all other methods fail is now an assured fact which the most skeptical would have hard work to disbelieve. What the possibilities of the method are or how great a revolution it may bring about in the oil business in the Trenton rock fields time will best prove. Of course, it is not claimed that oil can be made to flow where wells make no showing, but the promoters of the acid treatment claim to be able to greatly increase the production of wells which have, through age or other causes, fallen off. Wells which are located in good territory but which for reasons which the drill never satisfactorily discloses did not come in as large as their location warranted, will, it is thought, be especially helped by a treatment of hydrochloric acid.

On March 4 Jones & Bell's No. 1 well on the O'Connell farm, one-half mile south and one mile east of Gynnwood, O., Moulton township, Auglaize county, was treated and the results were highly beneficial. The well was five years old, had been shot with 80 quarts when drilled in and started off at 60 barrels. It had gradually dropped off in production until it was doing only six and one-half barrels. Since having been treated with the acid it has been pumping 20 barrels per day, an increase of over 300 per cent.

Remarkably good results were obtained on the same company's No. 5 well on the Beyham farm, in the same township. This well was only three months old and started off at 60 barrels, after having been shot with 160 quarts. It fell off so rapidly that the owners thought it was filled up, but when the tools were run such was not found to be the case, and it had almost been decided to shut the well down, as it was doing only two barrels. It was treated on March 10th and is now doing 45 barrels, an increase which will make quite a difference in the owner's credit balances at the end of the month.

The Sawyer Oil Company's No. 1 on the A. Tinsley farm, section 35, Nottingham township, Wells county, Ind.,

was treated January 27 and although not got to pumping until about the 1st inst., it shows a good increase in production. This well was over two years old, was shot when drilled in with 120 quarts and started off at 15 barrels, but had dwindled down to 1 2/3 barrels. It is now putting 14 barrels into the tank per day.

A. A. Scott & Co.'s No. 1 on the William Hydecker farm, section 1, Salem township, Auglaize county, was treated the last of January, and the production increased from three to six barrels, the smallest percentage of any of the four tests. The well was two years old, had been shot, when drilled in, with 80 quarts, and started off at 15 barrels. The most noticeable effect of the treatment in this well was the increase in the flow of gas, which was formerly quite light, but sufficient to furnish fuel to pump the well.

F. W. B.

PLAINTIFF'S EXHIBIT 149

OIL CITY DERRICK, TUESDAY MORNING, AUGUST 10, 1897

OIL NEWS
Ohio and Indiana
Buckland, Ohio

J. B. Kerr, receiver, has completed his No. 1 well on the William Bice farm, located in section 15, Amanda township, Allen county. The well was dry and abandoned after being treated with hydrochloric acid.

PLAINTIFF'S EXHIBIT 153

GYPSY OIL COMPANY CORRESPONDENCE AND REPORTS

Tulsa, Oklahoma, January 13, 1928.

Mr. R. S. Knappen,
Pittsburgh, Pa.

Assignment No. 38, Salt and Gyp Formations.

Dear sir: Today you are being forwarded by parcel post a sample of tubing from a well in the Glenpool field, externally coated with a gyp formation. This sample was taken from J. Spocogee No. 5 which is a property in the north extension of the Glenpool field in Section 17, Township 18 North, Range 12 East, Map No. 31. About three years ago this well ceased to produce on account of what seemed to be tubing trouble. Crew was assigned to pull tubing and when work was started it was found that tubing could not be raised. Two or three days were spent following out the regular procedure of injecting fresh water and salt water, and I believe gasoline was also used, but tubing could not be removed.

The well was a very small producer and all cleaning out tools of that division were employed on more important wells, and the expense of moving tools to this well was delayed from time to time until November 29, 1927, when the work was started. All tubing has been removed from the hole which was a case of pulling on it until it parted and then fishing it out by sections. We were successful in removing the barrel and anchor as well as the tubing. It was found that 420 feet of the tubing, including the barrel and anchor, were gyped in the same proportion as the sample that you will receive. The barrel and anchor were sent into Tulsa laboratory for investigation and analysis and later a complete report will be made up which will be passed through our Executive Department and will reach the Research Department through the regular channels.

This sample might be termed an extreme case but many similar cases have been experienced in the Glenpool field and a great number of a slighter form. This condition is responsible for an added expense to our operation in District No. 1 and particularly on the properties in the North Glenpool Field, but due to the fact that a careful study has not been made of it and operating expense for which it is responsible segregated, no estimate can be given, but I am sure that it is so serious that it is one problem that we should work on consistently, and if it is impossible to prevent the formation, if some chemical could be found to remove the gyp, it would in many cases avoid the expense of pulling tubing and in other cases of removing the tubing and cleaning out the hole with cable tools.

Yours very truly,

CPD:SG

Tulsa, Oklahoma, February 23, 1928.

Mr. Henry McGraw,
Building.

Assignment No. 38, Salt and Gyp Formations

Dear Sir: In the Glenpool field during the last ten years, precipitated solids have been very noticeable in many of our wells and this is now one of our real operating problems in that pool.

The gyp or salt formation occurs in working barrel, on valves, and on outside of tubing, and evidence obtained by samples of sand from wells reshot shows the same formation deposited on wall of sand. The extent of this condition has not been thoroughly checked as to area or as to the exact number of wells, but it is quite general and in many cases it has been so serious that rods or tubing could not be removed from hole until fished out with tools.

One instance, for example, is Jennie Spocogee No. 5 which has stood inactive for the past three years. This well was a small producer and when the trouble was discovered it was considered that tools being operated could be used on other properties to a greater advantage and the

work was put off from time to time. A short time ago tools were moved into this well and the tubing removed, which required several days. The scale, gyp, or solids on this string of tubing first appeared 21 joints from bottom in a formation 1/64th inch in thickness. From this point to the working barrel, the thickness of scale increased to 1/4th inch. In this well the tubing also showed the formation on interior. Samples of the formation and tubing were sent in to our laboratory where an analysis was attempted, same showing principally carbonates of calcium, magnesium, iron, a trace of barium, and some silica. It was my intention that samples would be prepared and held for your instructions and that the subject would be referred to the Research Department, Pittsburgh. However, in error, the samples of tubing scale and water samples taken from the well were forwarded by express to Mr. R. S. Knappen. This was due to the fact that Mr. Knappen had made inquiries concerning the difficulty and on a previous date had asked for such samples. The samples in question are now in Pittsburgh and have been turned over to Dr. Foote, and I would be pleased if you would address him on the subject.

Further investigation is being carried on by this department but the most active conditions that we have found to this date are on our Jacob Anderson lease on Section 9, Township 17 North, Range 12 East, on the J. P. Rhodes lease in Sections 20 and 21, same township and range, and on the Earl Berryhill South 40 acres, located in Section 9, same township and range. Later, I hope to have a more complete report on the extent of this trouble.

Yours very truly,

C. P. Dimit.

CPD:SG

Tulsa District, Research Problem No. 2.

Dr. Paul D. Foote,
Senior Industrial Fellow,
Mellon Institute of Industrial Research,
University of Pittsburgh,
Pittsburgh, Pa.

Dear Sir: A short time ago, Mr. Dimit's office sent to Mr. Knappen, at Pittsburgh, samples of a deposit which collects in the form of scale at the bottom of tubing strings in the Glenpool field, together with samples of the water from which, apparently, it was precipitated. It was the intention that these samples be sent to you, but through error, they were sent to Mr. Knappen. It is my understanding that these samples are now in your possession.

These particular samples are from Well No. 5 upon the Jennie Spocogee property, in the north extension of the Glenpool. In this well the deposit appeared upon the bottom twenty-one joints of tubing, varying in thickness from one sixty-fourth of an inch at the twenty-first joint, to one-fourth of an inch at the working barrel. Its deposition in this well is rather typical of its appearance in many wells in the Glenpool field, the deposit appearing upon the working barrels, valves, tubing, rods, and presumably the casing. Sometimes its thickness is such as to effectually cement the casing to the tubing. Occasionally, it is impossible to remove the rods and tubing without the use of fishing tools. Its appearance, while not universal, is sufficiently prevalent to present a serious annoyance. Our investigations have not been sufficiently extensive to determine whether the water carrying the undesirable minerals comes from the producing sand, or trickles down from upper formations through breaks in the casing, which in this area, as a rule, is more or less corroded.

It is my hope that you will be able to recommend some solvent, which will remove this deposit, or perhaps some means of preventing its deposition.

Yours very truly,

JDI*D

Plaintiff's Exhibit 153

Pittsburgh, Pa., May 24, 1928.

Mr. Henry McGraw, Vice President,
Gypsy Oil Company,
Box 2044,
Tulsa, Oklahoma.

Subject: Salt and Gyp Formation.

Dear Sir: In further reference to your letter of March 7th, describing Tulsa District Research Problem No. 2 relative to the salt and gyp formation in Well No. 5 on Jennie Spocogee property, Glenpool, this work will be designated under our serial number Ch-17. In a few days I shall submit to you a complete set of our research assignment so that there will be no further difficulty in referring to work in progress at this laboratory.

I enclose a memorandum by Dr. Wescott in which he requests some data relative to operation in the Glenpool.

Yours very truly,
Paul D. Foote,
Senior Industrial Fellow.

PDFoote:G

Pittsburgh, Pa., June 1, 1928.

Mr. Henry McGraw, Vice President,
Gypsy Oil Company,
Box 2044,
Tulsa, Oklahoma.

Dear Sir: I enclose a memorandum by Dr. Wescott relative to the removal of scale and gyp formation in the Glenpool field. He will have a complete report on this subject ready in a few weeks but if you desire to try some experiments before that time we shall be glad to send the inhibitor referred to.

Yours very truly,
Paul D. Foote,
Senior Industrial Fellow

PDFoote:G
Enclosure.

Memorandum on Scale and Gyp Formation.

It was suggested in a recent memorandum on this subject that a trial be made with muriatic acid to remove the scale deposit in a well of the Glenpool field. While it is probable that no serious damage to the tubing and casing would result it will be possible to practically prevent all action on them by the use of an inhibitor. I, therefore, suggest that if such a trial is to be made the research laboratory be notified far enough in advance so that the inhibitor may be sent together with directions for its use. This will effectively limit the action of the acid to the scale alone, protecting the casing and tubing completely.

B. B. Westcott.

Dr. Paul D. Foote,
Mellon Institute,
Pittsburgh, Pa.

June 4, 1928.

Dear Sir: Your letter of June 1st, on the subject of scale and gyp formation in the Glenpool field has been received, with the accompanying memorandum on an inhibitor.

I shall be glad to receive more information about the inhibitor. The casing in Glenpool is old and it seems undesirable to pour hydrochloric acid into the well for even a small amount of corrosion will eat through a thin pipe and admit large quantities of water through the well.

A previous letter asked for additional information, which data is being collected. In that letter I note a reference to the possible use of soda ash. If soda ash is to be used as an inhibitor, will it not result in the precipitation of these carbonates in the bottom of the well? If so, it would obviously plug off the oil sand which would be highly undesirable. As stated, I should be glad to have detailed information about the inhibitor which Doctor Wescott proposes for us.

Yours very truly,

RSK:MG

Plaintiff's Exhibit 153

Pittsburgh, Pa., July 19, 1928.

Mr. Henry McGraw, Vice President,
Gypsy Oil Company,
Box 2044,
Tulsa, Oklahoma.

Dear Sir: Herewith are two copies of a report by Dr. Wescott on the removal of scale and gyp from wells in the Glenpool. I believe that we have found something here well worth giving a careful trial. We have given the matter considerable study and are convinced that treatment cannot injure the well or the producing sand. In fact, as mentioned to you here, it should be very effective for removing gyp from the face of the sand. Certainly if there is enough of the gyp clogged on the tubing the sand must be badly contaminated and the removal of the gyp from the latter will increase production.

The cost estimates of Wescott are based upon very extreme conditions in a well so badly contaminated that it would be impossible to remove several hundred feet of tubing. Naturally if only 50 or 100 feet of tubing were clogged the cost would be proportionately less and I presume that it would not cost over $50.00 to give the face of the producing sand a thorough treatment. We shall await with interest your comments upon this proposition. As a gamble for increased production in this district it looks excellent to me.

Yours very truly,

PDFoote:G

Paul D. Foote,

Pittsburgh, Pa.

Mr. Henry McGraw, Vice President,
Gypsy Oil Company,
Box 2044,
Tulsa, Oklahoma.

Dear Sir: Enclosed is a memorandum on scale formation in wells by Dr. Wescott. This comment follows that given in his report sent you earlier. We shall greatly appreciate information relative to the questions listed in this

memorandum; especially we would like several typical gas analyses as described in our letter of May 24th. We wish to know the source of the carbon dioxide. If the oil originally contained large quantities of carbon dioxide it would probably be sufficient to explain the present gyp deposit. This would be shown by copies of gas analyses made when the field was young.

Yours very truly,

PDFoote:G Paul D. Foote.

Enclosure

cc. Mr. F. A. Leovy.

Memorandum on Scale Formation in Wells,
Blaine B. Wescott.

We are sending under separate cover, samples of tubing that were treated with concentrated hydrochloric acid containing different amounts of inhibitors. It is very much easier to visualize the effect of the acid from the specimens than from a table of results. You will readily see from these samples that the attack was nearly negligible in all cases where the inhibitor was used. The original roll marks are still visible in nearly every case.

In the event that a trial is made with this method, there should be a constant supervision over the work in order to safeguard against accidents from the acid. Of course, the well should be bailed as dry as possible before introduction of the acid. In view of the interesting possibilities connected with the experiment it might be desirable to have someone present from the Research Department.

Additional information might also be obtained concerning the possibility of preventing the formation of the scale. In this connection your attention is directed to our Memorandum of May ~~24th,~~ on this subject. In addition to the information requested at that time we would also like the following information:

1. How are the wells in this field pumped? (Information as complete as possible.)

2. If pumped by vacuum lift what is the vacuum maintained?
3. Is there any information showing whether there is a positive or negative pressure on the sand when the vacuum is taken off?
4. Are there many abandoned wells in this field and if so how are they closed off?
5. Is there any evidence of a negative pressure (vacuum) on abandoned wells which might allow air leakage into the producing sand?

July 20, 1928.

Pittsburgh, July 20, 1928.

Mr. Henry McGraw,
Tulsa, Oklahoma.

Dear Sir: You have received or will receive very shortly a copy of a report made by Dr. Blaine B. Wescott on scale formation in wells in the Glenpool and means for its removal. I discussed this at length with Dr. Foote yesterday and he repeats the assurance that there is no possible way in which this treatment can injure a well, either the steel or the sand.

Also, Dr. Foote is strongly of the opinion that this treatment will increase the production because he believes it will remove the gyp which must surely in many cases be deposited on the face of the sand. Therefore, entirely aside from the question of removing scale from tubing it would seem very probable that this method is a very desirable one for treating the producing sand. The cost is comparatively negligible.

For all these reasons I therefore endorse the recommendation made on page 18 of Dr. Wescott's report that the removal of the scale by use of hydrochloric acid and 4% Rodine No. 2 or other inhibitor of equal effectiveness be tried in one well in the Glenpool.

It is not vitally essential that you try the experiment in the Glenpool if you should conclude that there is some other well which for some reason would be a better one to use in making the test.

I know you feel as I do that this is a very interesting subject and I hope you will proceed as promptly as possible to make the test and that you will arrange to have a very accurate technical detailed report kept as to exactly how the test was made, a precise description of the material used, the subsequent experiments that are made to determine the effect, and all other details that may be necessary to make it possible to draw a correct conclusion from the experiment.

These reports of course should be sent to Dr. Foote and I would like to have copies sent to my office in duplicate. Also I suggest that the reports be sent out as you progress rather than to await the final result so that the Research Department, particularly, may keep up with the experiment as it progresses and perhaps make suggestions of value as the work proceeds.

Yours very truly,

H F. H. Leovy.

Production Department, Engineering Report.

Tulsa, Okla., August 24, 1928.

Subject Treatment of Gyp at Glenpool

Assignment No. 38. Written by R. L. Wright

Consulting Eng. Production Eng. R. L. Wright

The recent report on Gyp, written by Mr. Wescott, of the Gulf Oil Research Laboratories, transmitted to Mr. McGraw in the letter of June 1, 1928, is very interesting and seems to be logical.

I have discussed this report with Mr. Case and Mr. Hays. They both expressed an opinion that we should go ahead and try it out. While the report inferred that the prime cause for using this would be to wash the face of the sand for the purpose of increasing the production, Mr. Case and Mr. Hays both were of the opinion that from an operating point of view they would like to lubricate it into the well often enough to prevent the deposition of gyp. In other words, they would also expect an increase in production from more continuous operation.

Mr. Hays has selected William Berryhill No. 8 as the well in which he would like to make the experiment. The log of this well is as follows:

Completed April 28, 1907

6⅝ casing set 1425

Top of first sand 1428

Top of second sand 1493

We do not have the complete record of where the break is.

Well was shot 9-1-08 with 110 quarts during a clean out from 8-24-08 to 9-8-08.

From 6-1-19 to 6-21-19 well was drilled deeper to 1515 still in sand. It was shot with 40 quarts from 1482 to 1515.

From 10-6-22 to 11-16-22 well was cleaned out and shot with 20 quarts from 1491 to 1511. Production was increased from 1 to 5 barrels per day.

The present production of this well as shown by our July, 1928, individual well report is 5 barrels of oil and 13 water. The well has 27" of vacuum. It has a 2" Penrod Thompson barrel. The perforation is 19 feet off bottom. Well is pumped 6 hours per day with a motion of 12" stroke, running 14 strokes per minute.

Regarding our trouble with gyp. It gives us trouble both on the inside and the outside of the tubing. In both cases the trouble is near the bottom of the hole.

Analyzing the problem of using the suggested treatment: First we must consider there is an underground vacuum. This is strong enough so that water cannot be kept on bottom for cleaning out. Thus, we could not pull the tubing and dump in a large quantity of acid as it would go back into the sand. Where the tubing is pulled and when the well is put back on, it is sometimes 48 hours before the well starts producing. It seems the logical thing to do is to lubricate the acid into the well while it is still pumping and the vacuum is maintained. Regarding the amount of acid to use: It will take 2 pounds of commercial hydrochloric acid to dissolve one pound of calcium carbonate or scale. The scale weighs 181 pounds per cu. ft.

The amount of scale present is not known. Estimating that the scale is 1/16″ thick over 400 feet of annular space between the casing and the tubing, the scale being on each side of the tubing and the inside of the casing, and considering the face of the sand coated with the same thickness for 90 ft. of sand exposed over an average diameter of 5 ft. since the well has been shot heavily. The total of this gives 2640 sq. ft. of gyped surface. This gives approximately 14 cu. ft. of scale which should weigh 2530 pounds. The above thickness of scale was estimated after a discussion with all the farm bosses of the Glenn Pool District. On this basis, our requirements for acid then will be 5060 pounds. This amount of acid will cost approximately, at $2.10 per 100 pounds, $106.25.

The amount of inhibitor required for a 4% solution by volume would be 20½ gallons. At a cost of $3.50 per gallon the inhibitor would cost $71.75.

In carrying out this experiment in the field, there are other factors to consider. We would not want to take a chance of pumping this acid from the well to our stock tanks, as the inhibitor might deteriorate and the acid attack our tanks. We realize that the acid would be almost destroyed after it had attacked the scale, yet as a precaution, I believe we should set a small tank at the well and pump into it. Most of the water and weak acid would be drawn off and the remainder neutralized with ammonia lye or some other base before it is pumped into the stock tanks.

Another precaution we should take is, while the inhibitor practically protects steel, yet there is a slight attack. With a ball and seat just a slight wear soon causes it to cut out rapidly. For this reason, we should have a barrel that the standing valve can be pulled with the rods. A round trip could be made in a few hours with new balls and seats, and well put back on production.

For lubricating the acid into the well, we should arrange an air-tight lubricator, so that it will not interfere with the vacuum being pulled. This could be arranged with a barrel and a gauge glass that would make the amount of

fluid visible that was being lubricated. This should discharge into a connection at the casing head.

We should add the acid at a slow enough rate such that the total volume being produced from the well would not be more than the pump will handle.

I would recommend we proceed with this experiment by arranging with Mr. Hays to have a small tank set at the well, and install a new O'Bannon barrel. Have a suitable lubricator made at our shop, requisition 25 gallons of inhibitor and 5100 pounds of acid. Our own laboratory could furnish the necessary chemical apparatus for testing the fluid pumped from the well. The experiment should be watched very closely and a full report made on the results.

The amount of inhibitor recommended would be enough for us to make some tests on Waukesha and Superior engine blocks that are scaled up. This test could be made at our machine shop.

RLW:HG

Production Department, Engineering Report.

Tulsa, Okla., September 14, 1928.

Subject: Treatment of Gyp at Glenpool.

Assignment No. 38 Written by Fred W. Karl.

Consulting Eng., Hollis P. Porter.

Production Eng., R. L. Wright.

In Dr. Wescott's report on the above subject, the method of expressing the results of the water analyses is rather unfortunate as this method of hypothetical combinations is frequently misleading. For example, the combinations as given would indicate that no magnesium bicarbonate existed in the solution and yet a portion of the scale in each case was formed by the decomposition of magnesium bicarbonate as shown by the scale analyses. The point as to the presence of small quantities of strontium salts in the scale being due to occlusion can be more easily explained by calculation of the concentration of strontium sulfate. This shows that within the error of the analysis the concentration of strontium sulfate, not shown in the hypo-

thetical combinations, is equal to the solubility product and that the strontium in the scale was precipitated as sulfate.

Under the conditions of the well operation at Glenn Pool, the use of sodium bicarbonate to prevent the scale formation would not be feasible. This was demonstrated in the laboratory by adding the bicarbonate to a sample of water when considerable precipitate formed. This would be greatly increased in the well due to the action of the reduced pressure.

It is evident, as stated in the conclusions of Dr. Wescott's report that the release of dissolved carbon dioxide in the fluid as it enters the well cavity is responsible for the deposition of the scale, hence addition of more bicarbonate would be of little value in preventing scale accumulation. The third conclusion, that acid is the only commercially available solvent is not strictly true as will be discussed later. Under the sixth heading, it is stated that treatment of the fluid in the well is not economical. Actually this is not difficult, as several successful installations are in service for treating well fluid to prevent the formation of emulsions. Such an operation is particularly simple where the well is operated under vacuum. Again, the wells which are giving the greatest amount of trouble are producing less than ten barrels of water per day so that it should not be difficult to treat them.

Checking the calculations in Mr. Wright's report, it will require 2.3 pounds of 20° Be. acid to dissolve one pound of calcium carbonate and somewhat more if there is much of the magnesium carbonate associated with the calcium. Then, 2530 pounds of scale will require 5800 pounds of acid and 24 gallons of Rodine. This would increase the total cost of chemicals to $209.50.

As is suggested, there may be some trouble with the valve mechanism as it will be necessary to carry free acid past the valve in order to dissolve the scale in the tubing. If the process of lubrication is extended over a long period this may cause some corrosion of the ball and seat.

Conversation with the field foremen who are having

trouble from "gyp" formation developed that the real trouble is with the scale which forms inside the tubing. Many wells which show a full sixteenth of an inch of scale on the inside will have little or none outside. Although it is possible that much of the outside scale is knocked off in pulling, yet it would seem that some of it should remain to show that it had been there. When the scale forms inside the tubing string the working barrels scale heavily just above and below the travel of the cups. Then if the rod-line expands or contracts considerably so that the cups are forced into the scaled portion, they will bind and it is frequently necessary to pull the tubing to get the cups out of the barrel. Frequently the scale from the rods and tubing will fall into the barrel and being carried up and down by the cups, score the sides or jam the valves open and the pumping ceases. The following table shows the number of times certain wells have been off production because of "gyp" trouble during the first six months of the present year:

Lease	Well No.	Month or Months in Trouble	Production Oil	Production Water	Hours Pumped Per Day
J. Anderson	1	March, April	15	10	18
	3	February	7	5	12
	9	March, May	9	3	9
	23	February	11	5	10
A. Y. Barnes	2	March, April, June	10	6	18
	3	May	3	2	6
	7	May	3	½	4
	9	Jan., Feb., Mch., May	10	1	12
	16	April, June	10	6	15
E. Berryhill	3	February	9	2	10
	4	January	5	4	7
	5	June	10	8	18
	44	February	8	2	8
Wm. Berryhill	8	March	5	3	10
	9	January, April	5	10	24
	15	April	5	8	12

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Lease	Well No.	Month or Months in Trouble	Production Oil	Production Water	Hours Pumped Per Day
	26	February, June	10	10	24
	32	April	6	10	18
Clanton	6	May	4	4	7
	16	February, April	6	4	12
	17	Jan., Mar., Apr., May	4	4	12
M. W. Drew	2	February	5	2	12
	13	March, April	6	4	12
	15	March, May	8	4	18
	20	Jan., Feb., May	9	4	12
	21	Feb., April	9	6	18
	22	March	6	3	12
L. P. Escoe	8	February, March	6	8	24
T. Gilcrease	21	January, May	2	12	22
	22	June	4	5	13
R. L. Hood	6	January	1	4	4
	16	June	½	6	12
	17	January, February	2	6	12
	18	June	½	6	20
L. Pitman	10	April	3	3	12
	13	April	4	4	12
	16	March	3	5	12
	17	May	3	3	10
	18	May	2	3	8
	21	February	3	10	24
	28	March, April	3	5	7
R. Pitman	4	June	4	6	20
	8	January, April	3	4	10
	32	June	3	3	8
J. P. Rhodes	11	June	3	6	4
	15	February	½	15	10
B. Sells	9	March	7	0	24
Jennie Spocogee	3	May	2	3	4
Jacob "	6	February	½	10	24
Sam Vowell	3	May	9	5	11
	10	March	8	4	11

If the standing valve is working properly the scale could be removed from the tubing by running in about forty gallons of acid with the 1.6 gallons of Rodine needed for inhibition and allowing it to stand for a few hours, then pumping into a small tank with broken limestone in the bottom to remove any acid not used up in the reaction. Such a procedure would be less expensive than to treat all of the scale in the well, but would have no effect in increasing the production by removal of the scale on the face of the sand.

A simple experiment carried out by Mr. L. C. Case and the writer on a sample of the scale from the inside of the tubing indicated that the carbonates are fairly soluble in ammonium chloride (sal ammoniac) solution. This solution would have no effect on the well equipment and could be lubricated into the hole readily. It would require no added material to inhibit the corrosion reaction and as it is very soluble it would not cause any scale troubles. Experiments would be necessary to determine the concentration of the salt necessary and the amount of such solution needed to prevent further accumulation of scale in the well equipment.

Another method which might be used for preventing the formation of further scale would be to run into the well either a treated portion of the water produced by the well, such water to be freed from calcium and magnesium by the regular water treatment methods or simply a mixture of fresh water and water from the well, thereby increasing the amount of fluid in which the carbonates could be dissolved. The use of a water carrying some dissolved mineral matter would be necessary in order to prevent the formation of emulsion.

F. W. Karl.

FKW:HG

September 27, 1928.

Dr. Paul D. Foote,
c/o Mellon Institute,
Pittsburgh, Pa.

Dear Sir: I duly received the comprehensive report prepared by Doctor Wescott on the formation of "gyp" in wells with his recommendation that we treat one or more wells with acid and rodine. Experiments along this line have been delayed by the activity in Little River and elsewhere which demanded all the time of our available engineers.

The treatment of wells in Glenpool with this acid will be difficult because the pool has long been operated under high vacuum and the sand is so porous that as long as a well is open, air enters the well and passes through to adjacent wells on which vacuum is being maintained. Therefore, it will be impossible to open a well and pour in the acid. The vacuum would rapidly carry the acid back into the sand. Neither would it be feasible to put the acid in a well and maintain vacuum for the fluid would exert a pressure of 80 to 120 pounds per square inch over the face of the sand and the vacuum from surrounding wells would rapidly carry the water into the sand. These are not merely theoretical conditions. Experience in cleaning out work shows that it is very difficult to maintain water at the bottom of the hole sufficient to facilitate drilling and bailing operations.

Therefore, it appears that the only method by which the acid can be used in the hole is by permitting it to trickle down the casing and be immediately pumped out through the tubing. In this way, the casing, tubing and sand face can all be washed with acid without removing the vacuum. There would be little tendency for the acid to be drawn back into the sand since there would be no pressure against the sand face.

Accordingly, a lubricator will be designed through which the acid can be passed into the space between the tubing and casing while pumping is continuously carried on.

The acid with 4% of rodine No. 2 will be fed into the well and steadily pumped out. A chemist will be on hand to check the material and if the acid is not spent, it will be returned to the hole again. In this way, we shall accomplish a thorough washing of the face of the sand and should determine whether the sand is sealed off with carbonates as we all believe is the case. You will be advised of the results of the experiment when it is completed.

In part, this letter answers the questions raised in Doctor Wescott's memorandum which accompanied the report. Specifically, however, the information is as follows:

1. The wells in this field are pumped from two to eight hours per day. The stroke varies from 12 to 30 inches and the rate of pumping is about 14 strokes per minute.

2. Vacuum is maintained on all wells and ranges from 25 to 27 inches. This vacuum has been maintained for approximately ten years.

3. There is a definite negative pressure on the sand and air enters any well which is open and passes readily to adjacent wells.

4. Abandoned wells in this field have been plugged by filling with mud and capping the hole with cement. Analyses of gas from adjacent wells indicate that no appreciable amount of air enters the sand through the abandoned wells.

5. Abandoned wells are so plugged off that it is believed no air can enter the sand, although water might reach it.

It has been stated that the use of acid will in nowise damage the wells in Glenpool. On this matter I am not convinced. If the sand is cemented with calcium carbonate, it seems quite probable that the acid will loosen considerable sand and may result in much sand coming into the well. It is possible that we may have to move in tools and clean out if the acid-washing operation is carried too far. This is, of course, an additional argument in favor of using the continuous system rather than letting the acid stand in the hole for some time. Samples of Glenpool sand are not available to check this possibility.

It seems probable that the hole at the bottom of the well is much larger in Glenpool than many areas where the rocks are more solid. Field men report that after a shot it is not at all uncommon to remove scores of cubic feet of sand from the hole. In two cases, at least, we have lost strings of tools in the hole which could not be found by any fishing tool. Apparently they slipped off to one side and were entirely out of the reach of the fishing tools which were used to search for them. In another case, a bit was found lying crosswise in the hole and, of course, was not recovered. All of this evidence indicates that shooting and the repeated cleaning out of these wells may have developed cavities with cross-sections exceeding several square feet.

Yours very truly,

RSK:MG

November 20, 1928.

Dr. Paul D. Foote,
Mellon Institute,
Pittsburgh, Pa.

Dear Sir: I enclose a belated comment by Mr. Karl on Dr. Wescott's report on the Glenpool gyp.

The first experiment with the acid has been run at Glenpool with unsatisfactory results. I indicated in my previous letter that the acid might release much sand which would seriously interfere with pumping. Experience shows this is the case. The acid apparently destroyed much gyp but the pump was choked with sand and it has been necessary to pull the pump several times in order to get the well to pumping normally. The experiment has not yet been carried far enough so that we can determine whether the production of the well will actually be increased by this treatment. Further experiments will be made and you will be advised from time to time of the results.

I should note that Mr. Karl is not now so confident of the value of ammonium chloride as he was when he wrote this note. Further laboratory tests are being made but it appears that a very concentrated solution is necessary to

remove any large quantity of gyp. Such a concentration is not practical under ordinary field conditions.

Yours very truly,

RSK:GS

Tulsa, Oklahoma, February 5, 1929.

Dr. Paul D. Foote,
Mellon Institute,
Pittsburgh, Pa.

Dear Sir: The following preliminary report is quoted for your information, regarding the treatment of wells in Glenn Pool with hydrochloric acid:

(Here follows a copy of DX-152.)

The well is not equipped to permit the taking of an individual gauge of its production. However, the well pumped seven hours daily before treatment and since that time it has pumped at approximately the same rate. The treatment has apparently not benefited the well production. Whether it has reduced the amount of rod and pump trouble must be determined by further observation.

A peculiar feature of the operation is that no appreciable amount of water was recovered from the well. A small amount must have been present as shown by the acid reaction obtained by washing the oil. The loss of the water illustrates the ease with which vacuum pulled the fluid back into the sand when the well was opened.

Shortly I expect to treat the tubing in several additional wells, and further report on this subject will be sent you later.

Yours very truly,

RSK:AS

May 10, 1929.

Mr. M. O. Rife, General Superintendent,
Gulf Refining Company of Louisiana,
Shreveport, Louisiana.

Dear Sir: In the Glenpool field which you visited late Thursday afternoon, as I advised, we experience consider-

able operating difficulties due to a scale formation, generally referred to as "gyp."

The analysis of this material, according to a report of Mr. Stanley Gill under date of May 5, 1928, is as follows:

Insoluble materials	.30%
Iron and aluminum oxide	4.85%
Calcium carbonate	78.00%
Chloride	Trace
Strontium carbonate	10.80%
Organic and moisture	Balance

This scale very often causes rods and tubing jobs and when the material is pulled out of hole it is found that barrel and valve are so firmly set with it that it cannot be removed, and the equipment is junked. In some instances the formation has been on the outside of the tubing to the extent that it was necessary to move in tools and fish tubing out of hole.

When this matter was placed before the Research Department a treatment was recommended and a well on the William Berryhill farm was selected. This well had a record of tubing jobs in March, July, September, and November, of 1928, on account of gyp and during one month of this period tubing had to be removed from the hole four times. Since December 1, up to this date, this particular well has not been pulled on account of gyp formation. The treatment recommended was hydrochloric acid mixed with rodine. It apparently has worked out satisfactorily but its cost is prohibitive.

I was therefore interested in your statement that you have a like condition on one of your properties and that this gyp formation is being removed successfully with a chemical furnished by the William S. Barnacle Company of St. Louis, and no doubt the materials or chemicals that they furnish you can be used at a much less cost than the treatment used in our experiment. When you find it convenient, I will be pleased if you will advise the name or number of the chemical that the Tret-O-Lite people are furnishing you for this purpose.

Yours very truly,

CPD:SG

Pittsburgh, July 8, 1929.

Mr. Henry McGraw,
Tulsa, Oklahoma.

Dear Sir: Some time ago we had considerable correspondence with your office about gyped tubing. The last report by the Gypsy Oil Company on the removal of gyp by hydrochloric acid was made on February 5th. Prior to that time we had reports from you of considerable trouble with gyped tubing. It would be interesting to know whether the remedy suggested by our Research Department has been effective or whether you are still having trouble.

Yours very truly,
F. H. Leovy.

Tulsa, Okla., August 5, 1929.

Subject: Treatment of Gypsum at W. Berryhill No. 8.
Assignment No. A-17-6, written by R. L. Wright.
Consulting Eng. D. R. Trax. Production Eng. R. L. Wright.

The report of February 1, 1929, on the treatment of gypsum at W. Berryhill No. 8 stated that the well had not been pulled for gyped tubing since the treatment in November, 1928. The present status of the test is that the well has not been pulled for gyped tubing up to August 1st, 1929. The production of the well, however, has not increased.

This test has gone far enough to indicate that some pulling jobs for gyped tubing can be eliminated. However, it is doubtful if production can be increased. A summary of the results show this well was pulled three times in eight months previously to the treatment, and has not been pulled in eight months after the treatment.

The cost of the chemicals used in this particular treatment (hydrochloric acid with an inhibitor) was approximately $35.00.

We now have a chemical made by the W. S. Barnacle Company for gypsum treatment. The amount of the chemical recommended for a treatment is 100 lbs. This will

make the chemical cost approximately $10.00. We intend to make this test in the very near future. If it develops that the chemical made by the Barnacle Company will give as satisfactory results as using acid with an inhibitor, due to its low cost we would recommend its use.

RLW/b

Tulsa, Oklahoma, August 9, 1929.

Mr. F. A. Leovy,
Pittsburgh, Pa.

Dear Sir: Your letter of July 8th, without file number, requests a supplementary report on the treatment of a well in Glenpool with acid in order to remove the so-called "gyp." Attached is a report giving the limited information we have on this subject.

From this it appears that at a cost of $35.00 we have saved at least three pulling jobs on the well. The treatment has therefore been entirely successful and has resulted in a saving of not less than $20.00 on this well.

No improvement in oil production has been shown.

Due to the resignation of our chemist, we have not followed up this experiment as we wish to. Shortly I hope to treat other wells with acid and to extend these experiments in an effort to determine whether oil production cannot be improved as well as benefiting our production.

Yours very truly,

RSK:GS N

Production Department, Engineering Report.

Tulsa, Okla., August 30, 1929.

Subject: Test of Gyp Solvent X-1, manufactured by the Tret-O-Lite Company for Treating Gyp in Wm. Berryhill #26, on August 5, 1929.

Assignment No. 17-6, written by R. L. Wright.

Consulting Eng., D. L. Trax.

Production Eng., R. L. Wright.

The history of the well for the year previous to this test shows that the well was pulled three times for gyped

tubing, the last time being May, 1929. In August, 1929, the well was to be pulled again for gyp, so it was decided to test the gyp solvent in this well. The test was conducted on August 5, 1929, as follows:

The condition of the well was that it was impossible to pull the rods as the gyp in the upper part of the common barrel would not allow the plunger and cups to be pulled through it. Thus, it was a stripping job of pulling the tubing. An attempt was made to pour some of the treating compound down the tubing to attack the gyp in the upper part of the barrel, but the tubing was already full of salt water and the gyp solvent would not go down. Had this been successful, the tubing would not have been pulled unless the standing valve needed replacing.

The tubing itself was stuck to the casing by the formation of gyp. Fresh water was poured in the annular space between the tubing and the casing in an attempt to dissolve the gyp so that the tubing could be pulled. The well stood five hours to allow this to take place, but was not successful, as the tubing was still stuck. Ten pounds of gyp solvent dissolved in one barrel of fresh water was then poured down the annular space and the well allowed to stand for two hours. The tubing then pulled easily. A new common working barrel was then run back into the well.

After the tubing was rerun, 90 pounds of solvent dissolved in three barrels of fresh water were lubricated into the well. A small amount of this, however, was put in the tubing. The well was then put to pumping and run two hours, to get the chemical which was put in the annular space up into the tubing.

When the tubing had pumped up full, the well was shut down and allowed to set for 18 hours. It was then started up and the solvent was re-circulated for 12 hours. During the first part of this time a chemical test showed that some of the solvent was being re-circulated. However, after 12 hours, chemical test showed that the solvent had been destroyed by its action on the gyp. The manner in which the solvent was re-circulated was that it was pumped into a

barrel at the well head and allowed to drain from the barrel into the casinghead. In this barrel we found several small pieces of gyp which had been loosed from the tubing.

On August 8, 1929, or three days later, it was necessary to pull the well for cups. We feel that this cup job was probably caused by some small pieces of gyp getting down on the cups, cutting them out. On August 13th, the well was pulled, due to a leaking tubing point. An inspection of the tubing when it was out of the hole on this job showed that there was a considerable gyp left in the tubing.

The cost of this chemical is 11c per pound at St. Louis. A total of 100 pounds were used in this test. Its composition, according to Mr. Case of our laboratory who made the analysis, is impure ferric chloride.

The results obtained from this treatment, we feel, shows a small amount of benefit, but we do not feel that the treatment was anywhere near as successful as the treatment of William Berryhill No. 8, approximately nine months ago, with hydrochloric acid, using an inhibitor.

This checks the opinion expressed in the report of the Research Department under date of July 12, 1929, on Solvents for Scale Deposits in Wells.

In view of the above results, we recommend that we do not use any more of this particular gyp solvent.

RLW:HKG

Mr. W. B. Wilson, Tulsa, Oklahoma, July 21, 1931.
Building.

Subject: Explanation of results of acid treatment in Gypsy No. 3 J. Anderson.

Dear Sir: Results of this test have been observed since July 1, when the test was begun. Some of these results were stated in a letter of July 16. Since that time, it has been found that the addition of larger amounts of acid to the well definitely increases the bicarbonate in the water being produced with the oil. This rise in HCO_3 content, together with the increase in the calcium ratio of the water, show that the acid is encountering $CaCO_3$ on the casing in going down.

If acid were added directly to the water in the bottom of the well the reaction would be:

$$Ca(HCO_3)_2, + 2HCl = CaCl_2 + 2H_2O + 2CO_2$$

Also, if sufficient acid is added to calcium carbonate to bring about a complete reaction, we have:

$$CaCO_3 + 2HCl = CaCl_2 + H_2O + CO_2$$

However, if this reaction takes place in a phase of excess carbonate, the reaction is complete:

$$2CaCO_3 + 2HCl = Ca(HCO_3)_2 + CaCl_2$$

An example of the last reaction was performed in the laboratory. A solution of acid (1 to 20) was allowed to gravity through a 2 ft. column of crushed limestone. The reaction all took place in the first 2 inches of the column, that is, the acid was completely neutralized in that distance. The solution then percolated through the rest of the crushed stone without having any effect. This percolate was titrated and found to contain 298 p.p.m. of bicarbonate. This is precisely what is happening in the well.

Conclusions

When this treatment was suggested, no trouble was anticipated in getting the acid to the bottom of the well. It has been shown that the acid is being neutralized by scale on the casing, so that, after reaching the bottom, the solution increases the scale forming compounds in the water. This condition is the reverse of the desired result and the reverse of what would happen if the acid were added directly to the water.

Since the scale forming (calcium bicarbonate) material is increased in the water being pumped, it is entirely possible that more scale is forming on the valves and rods than before. However, there is also the possibility that the water contains sufficient carbon dioxide from the reaction to hold the scale in solution. In either case, it seems logical to conclude that present results do not merit a continuance of the test unless it is thought that larger quantities of acid will clean off the casing and allow the acid to get down.

Very truly yours,

L. C. Case.

c.c. Mr. Sanderson
Mr. Power
Mr. Rushmore

Pittsburgh, Pa., July 22, 1931.

Mr. K. Winship,
Tulsa, Okla.

Subject: Chemical Treatment of Wells. FA-20.

Dear Sir: During recent visits to Tulsa both Mr. Loomis and Dr. Wescott have discussed the possibility of preventing the deposition of gyp in wells of Glenpool and other similar fields by two possible methods:

First: The lubrication of acid Rodine mixtures continuously into the wells, and

Second: The lubrication of a protective colloid to prevent the formation of a hard scale.

There seems little doubt that the scale is formed as the result of the release of carbon dioxide from the water when it enters the hole. In order to determine the feasibility of the second method mentioned above, we would like to request the shipment of two 5-gallon carboys of Glenpool water to the laboratory. No experimentation is necessary in the laboratory for the use of the first method mentioned above since the amount of acid required can be readily calculated from the analysis and the amount of water produced, and it can then be lubricated into the well in the same manner as is now used for the Tret-o-lite paraffin remover. However, it will be necessary to conduct laboratory tests to determine the value of protective colloids in keeping any calcium carbonate released in the form of a sludge which will be flushed from the well with the fluid produced. The water requested will be used for this latter purpose.

Very truly yours,

BBW:NCK (Signed) Paul D. Foote.

Production Department Memorandum
Monthly Summary & Progress Report.

October 1, 1931.

Water Treatment:

The Gypsy Oil Company has three International Water Softening Plants. However, only two are in operation at present, those at Jenks and Little River. The treat-

ment at the plants seems to be effective, the water seldom showing more than 3 to 5 grains total hardness.

The last shipment of lime to the Jenks plant was found to be of inferior quality from the standpoint of water treatment. Satisfactory results required the use of approximately 75% overcharge of lime. This item will be watched to see that lime of the correct analysis is purchased in the future.

Salt and Gyp Treatment:

A test covering a period of 18 days was conducted in Jacob Anderson well #3 to determine the effect of a daily charge of hydrochloric acid in the hole on the formation of "gyp" or calcium carbonate. Results of tests on the water produced led to the conclusion that the formation of scale was being accelerated instead of inhibited. Further work will be done along this line.

Production Department, Engineering Report.

Tulsa, Okla., December 4, 1931.

Subject: Prevention of Scale Deposition in J. Anderson Well No. 3.

Assignment No. 17-B, written by W. L. Rushmore.

Consulting Eng., D. L. Trax.

Production Eng., H. H. Power.

Conclusions.

The test at J. Anderson Well No. 3 was started on July 1st, and discontinued on July 20th. The first intentions were to make at least a thirty-day trial but in light of the results obtained and the possibility that more scale was being formed than would be naturally, it was thought advisable to discontinue the trial.

The above conclusions were arrived at after the water began to show a very high bicarbonate content which was the exact opposite to what had been expected.

It has been decided to try mechanical means of combatting the carbonate formation.

* * * * * *

Plaintiff's Exhibit 153

Production Department, Engineering Report.

Tulsa, Okla., April 12, 1932.

Subject: Gyp Scraper in T. Gilcrease No. 21.
Assignment No. 17-6, written by W. L. Rushmore.
Consulting Eng., D. L. Trax.
Production Eng., H. H. Power.

Conclusions.

It is concluded from the results of this trial that the use of a scraper plunger in gyp wells as a mechanical means to prevent deposition of scale will materially reduce pump trouble.

It is recommended that further trials be made of this type plunger in the Glenpool District.

* * * * *

Considerable trouble has been experienced with the formation of "gyp" in the common barrel with which Thomas Gilcrease well No. 21 is produced. The "gyp" or calcium carbonate was deposited in the working valve, in the barrel above and below the cup travel, in the lower part of the tubing and on the lower sucker-rods. Frequent cup jobs occurred, caused by the scale cracking off the rods and tubing and falling down in the pump. Too, the scale would gradually build up in the barrel, above the cup travel, until the top of the barrel was so restricted that it was not possible to pull the working valve. A tubing job would result. Treatment with hydrochloric acid, down the hole, in a similar well was not successful. It was decided that mechanical means would offer a more effective method of combating this trouble.

Trials have been made in the Cleveland District of a scraper tube used in the place of the common valve stem. The tube was of such a length that it would work out of the top of a common barrel at all times, and would fit the barrel close enough to scrape any deposition off as it was formed.

A similar plunger was made up for use in Thomas Gilcrease Well No. 21 in the Glenpool. A worn out O'Bannon tube with top bushing and crown formed the body of the plunger. The connection between the lower end of the

tube and the working valve was made of an O'Bannon part L. B.-13 which had been turned down to allow a free movement inside a 1-25/32" A. P. I. common barrel, and which had male threads cut on the upper end so as to screw into the tube. The common valve body carrying 1-25/32" cups was screwed into this bushing. The connecting bushing also carries the traveling valve ball and seat. The attached sketch shows the position and appearance of the plunger in a common barrel.

The scraper, as described above, was run in Thomas Gilcrease Well No. 21 on October 14, 1931. The trouble record of this well from January 12, 1931, to March 31, 1932, and the resulting costs are shown in the attached table.

A marked decrease in trouble will be noted in the table. The well was serviced twelve times in 271 days, or on an average of once in 22 days. The first pulling job occurred 158 days after the scraper was installed. However, it seems to be hanging up on October 17, 1931, three days after its installation. The well was bumped and put to pumping with no further trouble until it was pulled for cups on March 22, 1932.

The table shows a cost of $0.404 per day before installation of the scraper and $0.23 per day after. The decrease in the days servicing costs amounts to 43 per cent. The charge of the tubing job on October 14, 1931, when the scraper was installed, covering labor and material amounting to $26.89, was included in the cost of operating the well after the scraper was installed. A more decided decrease should be noted after a longer operating period.

RLR:AHB.

Production Department, Engineering Report.

Tulsa, Okla., April 14, 1932.

Subject: 1" B. M. W. Pump—Jacob Anderson No. 3.
Assignment No. 17-6, written by
Consulting Eng.,
Production Eng.,

Conclusions.

The results obtained from the 156-day trial of the 1" B. M. W. pump in Jacob Anderson Well No. 3, do not warrant its further continuation in this well.

Recommendations.

It is recommended that the 1" B. M. W. pump be removed from this well and that a scraper plunger such as is now in use in Thomas Gilcrease No. 21 be installed. The small pump should be transferred to a well not troubled with gyp.

* * * * *

Several wells in the Glenpool produce a water from which "Gyp" or calcium carbonate, is deposited on the producing equipment. Sand is also present in these same wells. Under these producing conditions the maintenance cost of a working barrel is excessive.

Jacob Anderson No. 3 shows both sand and gyp and is a consistent trouble maker. Attempts were made in July, 1931, to control the gyp deposition by means of hydrochloric acid introduced in the hole. The results of these trials were not favorable. Attention was then turned toward the possibility of inhibiting the scaling action by physical or mechanical means. It was thought that continuous pumping at a slow rate might produce a smoother flow of fluid through the pump thereby offering less opportunity for the escape of CO_2 from the water. The precipitation of the scale is caused by the escape of the CO_2 from the bicarbonate, which leaves the insoluble carbonate.

The power on the Anderson lease is operated at 8 strokes per minute which is at the lower limit of its speed variation. This particular well produces 8 barrels of oil and 3 of water on an 8-21" cycle. The pumping time when

using a common barrel was 12 hours daily. To obtain slower pumping necessitated the use of a small capacity pump.

A 1" B. M. W. pump was installed on October 27, 1931, and operated on the same cycle as the common barrel but was operated straight time. The small pump was pulled the first time on December 10, 1931, for cups. This was a 44-day run and incidentally the longest run obtained to date.

The attached table includes the trouble record and material and labor cost for pump service only from April 1, 1931, to April 2, 1932. The table shows a slight increase in operating expense for the small pump as against the 2" common barrel used previously. However, over an equal period of time the cost might possibly show a decrease. It can hardly be expected, judging from the data now at hand, that a large difference in service charge will ensue from its continued use.

It was observed that the small pump would become encrusted with scale in the same manner as the common barrel. However, the small pump would cause trouble sooner than the larger one because the smaller fluid passages would be reduced with resulting flow restrictions. The use of the small pump is advantageous in that it can be installed on the rods and not cause a tubing job.

It cannot be said that operating conditions in this well have been improved, even though the pumping time has been lengthened from 12 to 24 hours. The pump efficiency was increased slightly, from 50% to 58%.

It is recommended that the 1" B. M. W. pump be removed from this well and that a scraper plunger such as is now in use in Thomas Gilcrease No. 21, be installed. This plunger was described in a report dated April 12, 1932.
WLR/AHB.

Plaintiff's Exhibit 153

Pittsburgh, Pa., May 14, 1932.

Mr. K. Winship,
Tulsa, Okla.

Subject: Prevention of Scale Deposition. FA-21-1.

Dear Sir: In a letter dated January 12th you discuss scale deposition troubles in Glenpool wells and point out that it would be too costly to treat the fluid in the bottom of the hole with acid, for scale extends from 200 to 400 feet up from the bottom of the casing and all of this scale would have to be removed before the acid would reach the bottom-hole-fluid. You suggest that, if possible, a treater should be developed that would not be destroyed by reaction with the scale before reaching the bottom.

We have in mind that a cheap colloid, such as tannin, might be added down the casing. This colloid is recommended as a boiler feed-water treater and acts in some way by absorption to cause calcium carbonate to form a flocculent precipitate rather than a fine crystalline powder, thus destroying the tendency to scale, with the result that the flocculent material is easily eliminated when the boiler is blown down. As an example, our analysis of Dearborn Boiler Scale Remover shows that tannin is the main constituent.

It appears by analogy that the same treatment might be used to prevent scale deposition in the wells. An alkaline solution of tannin should cause the calcium carbonate to form as a gelatinous precipitate, which would float out with the liquid. The scale already in the casing would not destroy the chemical on its way down, of course, as is the case with hydrochloric acid. A few experiments that we have tried in glass and steel beakers showed that the scale-forming properties of calcium carbonate are destroyed by small amounts of tannic acid, sodium tannate, waste alkaline liquor from the Lake Charles (La.) Products Company and Stabilite. These latter two products contain tannins.

I believe that we can conclude that the proposed method of treatment is somewhat promising if the cost is not too great. Wescott and Loomis are planning a series

of tests with a constant amount of calcium carbonate in each case to find the smallest concentration of tannin necessary to prevent scale-forming tendencies and hence obtain some idea of the cost involved. The results of these tests will be reported to you as soon as possible.

Yours very truly,
AGL:P Paul D. Foote.

July 29, 1932.

Mr. K. Winship,
Tulsa, Okla.

Subject: Chemical Treatment of Wells—Gyp—Fa-20-1.

Dear Sir: In connection with our work on the prevention of gyp formation in oil well tubing we would like to obtain a piece of pipe covered with a good coating of gyp for the purpose of chemical and physical examination, and a sample of water from the same well for a similar purpose.

We have been considering gyp prevention and the problem is one which will be continued over a considerable period of time but one which, from the nature of the tests, requires practically no man hours. The apparatus is set up and run for a period of several days with little or no attention. We are in no hurry for this material but shall appreciate samples at your convenience.

Yours very truly,
PDF:G Paul D. Foote.

October 13, 1932.

Memorandum.

Today Mr. A. T. Wright, who stated he was associated with the Dow Chemical Company of Midland, Michigan, called on me. He stated that the Dow Chemical Company had been making some experiments with lime producers in Michigan fields by placing acid in wells. From 500 to 1000 gallons of acid are placed in a well through tubing, and pressure is then applied and the well allowed to stand 48 hours. A charge of $250.00 is made for the acid and labor required to place it in the hole.

Mr. Wright stated that in some cases remarkable results were obtained. He cited W. L. McClanahan's Shaffer #1 test in the East Mt. Pleasant pool. He stated that this well had an initial production of 125 barrels daily. It declined at a moderate rate for 25 days and then was treated with 1000 gallons of hydrochloric acid (20% concentrated), and it responded with a production of 725 barrels daily. At the end of 24 days the production had dropped to 336 barrels but in the meantime it had produced 8,600 barrels above what it was estimated it would have produced without the acid treatment. The test was then given another treatment of 1000 gallons of acid and the production thereby was raised to 850 barrels daily. Mr. Wright stated that the results in the case of this test were unusually successful but that the other wells had responded to the acid treatment with very substantial increases in production.

Mr. Wright also advised that the Dow Chemical Company, which is one of the largest, if not the largest chemical company in the United States, employing 3,500 men, became interested in treating wells with acid in an effort to use some of the acid by-products of their plant at Midland. This company has the process patented and has also a copyright on an inhibitor which is placed in the acid to prevent excessive corrosion of well equipment. Care must be used in using the acid with wells which are making water since in some cases the water content instead of the oil content has been increased. In general the process is expected to work best in situations where production is obtained from limestone of variable porosity and where the oil is accompanied by little water.

There is a possibility that this method of treating wells will have a practical applicability in Mid-Continent fields, and among the producing horizons the Hunton lime appears to be most suitable for trials. There is not much water in the Hunton lime and the variability of its porosity is illustrated by such wells as our L. Tiger No. 2 in Sec. 3-8-5. It will be recalled that No. 1 Tiger was a 3,500-barrel well and No. 2 only made about 75 barrels.

Mr. Wright is in Tulsa for the purpose of collecting samples of various lime producing horizons and interesting producers in trying out the acid treatment at some later date. He has associated himself in Tulsa with Mr. Frank Juerta who has offices in the Kennedy Building. As the treatment is relatively inexpensive there can be little doubt that it will be given a rather thorough trial in Oklahoma.

W. B. Wilson.

Dowell, Inc., January 18, 1933.
Midland, Michigan.

Gentlemen: On October 13, 1932, Mr. A. T. Wright called on me and represented himself as being associated with your Company. He did not exhibit a contract with you, but stated that he was authorized to solicit business for you in this territory. On this representation Mr. Wright received from us samples and cuttings from various representative lime wells in our territory, which he stated would be examined by you, in return for which we would be furnished the results of your analyses. The materials which our records show were turned over to Mr. Wright are listed below:

Oil Well Cuttings.

Gypsy Oil Company Nos. 1, 2, 4, 5, and 6 Cecil—Section 19-7N-4E, Oklahoma.
Gypsy Oil Company #1 Collins—Section 25-7N-4E.
Gypsy Oil Company #2 McGee—Section 23-7N-4E.
Darby Oil Company #1 Standridge—Section 15-7N-4E.

Oil Well Cores.

Texas Oil Company #1 Dinah—Section 23-5N-7E.
W. B. Pine #1 Tiger—Section 3-8N-5E.
Empire Oil #1 Alexander—Section 23-6N-3E.
Droppleman #1 Jones—Section 21-8N-3E.
Gypsy Oil Company #1 Masters—Section 25-6N-4E.
Gypsy Oil Company #1 Tiger—Section 3-8N-5E.

On November 27, 1932, Mr. Wright again called on me and stated that he was no longer representing you in this territory. He gave me written in longhand on Dowell, Inc.,

stationery, results of analyses of cuttings from Gypsy No. 1, 2 and 4 Cecil, listed above. He stated these were all the determinations that had been furnished him to date. We have received no others. Our purpose in writing you is to find out if, in fact, Mr. Wright ever submitted to you any other cores or cuttings which we furnished him, and if so, whether you can now give us results of your analyses of them. Some of these materials can be duplicated only with difficulty, if at all. Hence our desire to have a report on them. Recently your Mr. J. A. Cummin stated to us that he recalled analyses had been made of our materials, but he did not know to what extent. If your records show that these materials were received by you and have been examined, I assume it will be in accord with your policy to furnish us a copy of the analyses and we will greatly appreciate receiving them.

Yours very truly,

WBW:LAP

January 23, 1933.

In reply please refer to
J. W. Harris.

Gypsy Oil Company,
Tulsa, Oklahoma.

Attention Mr. W. B. Wilson.

Gentlemen: Your letter of January 20 regarding samples sent in by Mr. A. T. Wright has been received.

We have received all the samples listed by you from Mr. Wright and have analyzed them all. The results of the samples of the first four wells listed were sent directly to Mr. A. T. Wright at the time of analysis, but after hearing of Mr. Wright's misrepresenting himself as being our agent we did not send him the results of the analyses of the other samples. We did, however, send the results to our representative in Oklahoma at that time, Mr. John Staudt.

We have found that the results of the analyses prove to be very favorable for our type of treatment on all of these latter samples. We can tell by the percentage of solubility and percentage of Calcium Carbonate just about what suc-

cess we can have with our treatment on those certain wells. All of the samples had a high enough solubility and percentage of Calcium Carbonate for our treatment to be very successful.

This is all the information that we can give you by letter. We are very sorry that we cannot make public on paper the exact results which we obtained. Perhaps Mr. Staudt can make a trip to Tulsa in the near future and see you personally. In that case we are sure that he could give you a better idea of these analyses.

Yours very truly,
Dowell Incorporated,
JWH:JL J. W. Harris, Sales Department.

Dowell, Inc., January 30, 1933.
Midland, Michigan.

Attention Mr. J. W. Harris.

Dear Sirs: I wish to refer again to the subject-matter discussed in your letter to me of January 23 pertaining to well samples and cores furnished you by us thru A. T. Wright.

I am not sure that I have been able to make our position in this matter clear to you. As we see the situation, we were approached by a man who had certainly had some connection with your company. Upon his representation that he was authorized to solicit business for you he was furnished with materials from various wells, some of which cannot be replaced. It is customary in the oil business for companies to be furnished with copies of analyses of rock samples or water samples furnished by them to parties interested in making such analyses. If Mr. Wright had no connection with you it would have seemed only ordinarily prudent for you to check up with us, before making analyses of these materials, any obligations going with them. You state that you sent Mr. Wright results of analyses of four wells, but sent him no more at hearing that he was misrepresenting himself as your agent. It appears from this that it was your original intention to furnish him

copies of all analyses. Such being the case, we cannot understand why we, who furnished the materials, should be held in a different status than was Mr. Wright originally.

In this connection I will say that it is not our intention to furnish Mr. Wright with these analyses or to make them available to the public. I will say further that the Gypsy Company is the Oklahoma and Kansas producing subsidiary of the Gulf Oil Company of Pennsylvania, one of the world's largest producers of crude oil. We believe that an investigation will reveal to you that our company is widely known for its honorable dealings and that it can be relied on to fulfill any agreements made by it.

I hope that a reconsideration of the facts will lead you to the conclusion that in accepting and using materials you necessarily assumed the obligations made in securing them and that you will decide to furnish us with the analyses in question. I agree on the part of the Gypsy Oil Company to see that they are kept confidential within our Company.

Yours very truly,

WBW:LAP

February 6, 1933.

Gypsy Oil Company,
Tulsa, Oklahoma.

In reply please refer to
J. W. Harris.

Attention: Mr. W. B. Wilson.

Gentlemen: This is in reference to the matter concerning the well samples and cores which you furnished us through Mr. A. T. Wright some time ago.

We agree with you that you are not in a different status than Mr. Wright was originally when we sent him the results of our analysis. It is not our intention to keep you from receiving these results but rather the fact that it is against our policy to send these results by letter. Mr. S. W. Putnam, the Manager of Dowell Incorporated, is at the present time making a trip into Kansas, Oklahoma, and Texas. In this trip he plans on calling on you, and he has been furnished with a complete report of the results which you lack.

Hoping that you may have the opportunity to talk with Mr. Putnam when he calls on you in Tulsa, we are—

Yours very truly,

Dowell Incorporated,

JWH:JL J. W. Harris, Sales Department.

(Letterhead of Gypsy Oil Company, Tulsa, Okla.)

(Stamped): Dow Rec'd 1933 Jan 21 AM 9 01.

January 19, 1933.

Dowell Incorporated,
Midland, Michigan.

Gentlemen: We have noted with interest the result of acid treatment as applied to oil wells, and the rapid spread of this method of treatment throughout the Mid-Continent area.

We have in mind the possibility of treating certain of our wells in the State of Kansas, and in this connection would like to know whether or not your company will be prepared to service wells in that area within the near future. If you have a specific plan formulated, we would like to know the date on which your service will be available.

Very truly yours,

S. G. Sanderson,

General Superintendent.

TABLE I

Metal strips of strap iron (Series D and B) approximately 1" x 7/8" x 1/8" were used. The solutions were not agitated. The experiments were carried out at 85°F., the volume of the acid solution used per test was 50 cc., and the time of the tests was 16 hours.

Series D	% Hydrochloric Acid	Initial Weight (Grams)	Final Weight (Grams)	Loss in Weight (Grams)	% Loss in Weight	% Reduction in Corrosiveness
Sample 8 (Stella Wilcox)	14.8	14.4300	14.1386	0.2914	2.02	
" " " "	14.8	14.4282	14.1371	0.2911	2.02	
" " " "	14.8	14.4341	14.1487	0.2854	1.98	
	Average	14.4308	14.1415	0.2893	2.01	47
Blank 8 (C. P. HCl)	14.8	14.4407	13.8942	0.5465	3.78	
" " " "	14.8	14.4080	13.8667	0.5413	3.76	
" " " "	14.8	14.4375	13.8840	0.5535	3.83	
	Average	14.4287	13.8816	0.5471	3.79	—
Sample 12-B (Zahn)	14.5	14.6236	14.3606	0.2630	1.80	
" " "	14.5	14.6142	14.3493	0.2649	1.81	
" " "	14.5	14.6131	14.3490	0.2641	1.81	
	Average	14.6170	14.3530	0.2640	1.81	48
Blank 12-B (C.P. HCl)	14.5	14.6114	14.1134	0.4980	3.41	
" " " "	14.5	14.6136	14.1192	0.4944	3.38	
" " " "	14.5	14.6004	14.0748	0.5256	3.60	
	Average	14.6085	14.1025	0.5060	3.46	—
Series B						
Sample 5 (Stella Wilcox)	14.8	14.3847	13.9196	0.4651	3.23	
" " " "	14.8	14.2756	13.8045	0.4711	3.30	
" " " "	14.8	14.1528	13.6974	0.4554	3.22	
	Average	14.2710	13.8072	0.4639	3.25	42
Sample 6 (Stella Wilcox)	14.8	14.3080	13.8577	0.4503	3.15	
" " " "	14.8	14.1734	13.7261	0.4473	3.16	
" " " "	14.8	14.4104	13.9486	0.4618	3.20	
	Average	14.2973	13.8441	0.4531	3.17	43
Average of 5 and 6				0.4585		42.5
Blank 5-6 (C.P. HCl)	14.8	14.3526	13.5577	0.7949	5.54	
" " " "	14.8	14.4171	13.6118	0.8053	5.59	
" " " "	14.8	14.2457	13.4500	0.7957	5.58	
	Average	14.3385	13.5398	0.7986	5.57	—
Sample 12 (Zahn)	14.5	14.3540	13.9100	0.4440	3.09	
" " "	14.5	14.4121	13.9482	0.4639	3.22	
" " "	14.5	14.2618	13.8079	0.4539	3.18	
	Average	14.3426	13.8887	0.4539	3.16	42
Blank 12 (C.P. HCl)	14.5	14.4024	13.6256	0.7768	5.39	
" " " "	14.5	14.4582	13.6765	0.7817	5.41	
" " " "	14.5	14.4568	13.6708	0.7860	5.44	
	Average	14.4391	13.6576	0.7815	5.41	—
Sample 15 (Crawford) 8-23-39	15.2	14.3987	14.1542	0.2445	1.70	
" " " "	15.2	14.1081	13.8552	0.2529	1.79	
" " " "	15.2	14.1509	13.8926	0.2583	1.82	

" " " "	14.8		14.1734	13.7261	0.4473	3.16	
" " " "	14.8		14.4104	13.9486	0.4618	3.20	
		Average	14.2973	13.8441	0.4531	3.17	43
Average of 5 and 6					0.4585		42.5
Blank 5-6 (C.P. HCl)	14.8		14.3526	13.5577	0.7949	5.54	
" " " "	14.8		14.4171	13.6118	0.8053	5.59	
" " " "	14.8		14.2457	13.4500	0.7957	5.58	
		Average	14.3385	13.5398	0.7986	5.57	—
Sample 12 (Zahn)	14.5		14.3540	13.9100	0.4440	3.09	
" " "	14.5		14.4121	13.9482	0.4639	3.22	
" " "	14.5		14.2618	13.8079	0.4539	3.18	
		Average	14.3426	13.8887	0.4539	3.16	42
Blank 12 (C.P. HCl)	14.5		14.4024	13.6256	0.7768	5.39	
" " " "	14.5		14.4582	13.6765	0.7817	5.41	
" " " "	14.5		14.4568	13.6708	0.7860	5.44	
		Average	14.4391	13.6576	0.7815	5.41	—
Sample 15 (Crawford) 8-23-39	15.2		14.3987	14.1542	0.2445	1.70	
" " " "	15.2		14.1081	13.8552	0.2529	1.79	
" " " "	15.2		14.1509	13.8926	0.2583	1.82	
		Average	14.2192	13.9673	0.2519	1.77	69
Sample 15 (Crawford) 8-31-39	15.2		14.3501	14.1053	0.2448	1.71	
" " " "	15.2		14.2577	14.0275	0.2302	1.61	
" " " "	15.2		14.3102	14.0685	0.2417	1.69	
		Average	14.3060	14.0671	0.2389	1.67	71
Average of 15					0.2454		70
Blank 15 (C.P. HCl)	15.2		14.3538	13.5342	0.8196	5.71	
" " " "	15.2		14.1188	13.3038	0.8150	5.77	
" " " "	15.2		14.3114	13.4929	0.8185	5.72	
		Average	14.2613	13.4436	0.8177	5.73	—

TABLE II

ACID CORROSION TESTS

Metal Strips from an oil well pipe of the National Supply Company approximately 1" x 7/8" x 3/16" were used. The solutions were not agitated. The experiments were carried out at 85° F., the volume of the acid solution used per test was 50 cc., and the time of the tests was 16 hours.

	% Hydrochloric Acid	Initial Weight (Grams)	Final Weight (Grams)	Loss in Weight (Grams)	% Loss in Weight	% Reduction in Corrosiveness
Sample 5 (Stella Wilcox)	14.8	20.9523	20.5500	0.4023	1.92	
" " " "	14.8	18.9880	18.5954	0.3926	2.07	
" " " "	14.8	21.0014	20.5900	0.4114	1.96	
	Average	20.3139	19.9118	0.4021	1.98	25
Sample 6 (Stella Wilcox)	14.8	19.3654	18.9608	0.4046	2.09	
" " " "	14.8	20.7884	20.3645	0.4239	2.04	
" " " "	14.8	19.0534	18.6746	0.3788	1.99	
" " " "	14.8	19.4437	19.0704	0.3733	1.92	
	Average	19.6627	19.2676	0.3952	2.01	24
Sample 8 (Stella Wilcox)	14.8	19.1848	18.8046	0.3802	1.98	
" " " "	14.8	19.1752	18.7907	0.3845	2.00	
" " " "	14.8	19.1166	18.7400	0.3766	1.97	
	Average	19.1589	18.7784	0.3804	1.98	25
Average of 5, 6 and 8				0.3926		25
Blank 5-6-8 (C.P. HCl)	14.8	19.3808	18.8664	0.5144	2.66	
" " " "	14.8	19.4710	18.9650	0.5060	2.60	
" " " "	14.8	20.6994	20.1729	0.5265	2.54	
" " " "	14.8	19.1257	18.6350	0.4907	2.56	
" " " "	14.8	19.1594	18.6472	0.5122	2.67	
" " " "	14.8	19.0673	18.5460	0.5213	2.73	
	Average	19.4839	18.9721	0.5118	2.63	—
Sample 12 (Zahn)	14.5	17.9335	17.5702	0.3633	2.03	
" " "	14.5	16.7113	16.3792	0.3321	1.99	
" " "	14.5	21.6454	21.2548	0.3906	1.80	
	Average	18.7634	18.4014	0.3620	1.94	23
Sample 12-B (Zahn)	14.5	18.9359	18.5833	0.3526	1.86	
" " "	14.5	18.9569	18.6074	0.3495	1.84	
" " "	14.5	18.9050	18.5472	0.3578	1.89	
" " "	14.5	18.6880	18.3383	0.3497	1.87	
	Average	18.8714	18.5190	0.3524	1.86	26
Average of 12 and 12-B				0.3572		24.5
Blank 12-12-B (C.P. HCl)	14.5	19.5891	19.1114	0.4777	2.44	
" " " "	14.5	18.1447	17.6659	0.4788	2.64	
" " " "	14.5	18.3639	17.9077	0.4562	2.48	
" " " "	14.5	18.9834	18.5066	0.4768	2.51	
" " " "	14.5	18.9287	18.4288	0.4999	2.64	
" " " "	14.5	18.9680	18.5024	0.4656	2.45	
	Average	18.8296	18.3538	0.4758	2.53	—
Sample 15 (Crawford) 8-23-39	15.2	16.8811	16.6213	0.2598	1.54	
" " "	15.2	16.9076	16.6521	0.2555	1.51	
" " "	15.2	18.4502	18.1831	0.2671	1.45	

" " "	14.5		16.7113	16.3792	0.3321	1.99	
" " "	14.5		21.6454	21.2548	0.3906	1.80	
		Average	18.7634	18.4014	0.3620	1.94	23
Sample 12-B (Zahn)	14.5		18.9359	18.5833	0.3526	1.86	
" " "	14.5		18.9569	18.6074	0.3495	1.84	
" " "	14.5		18.9050	18.5472	0.3578	1.89	
" " "	14.5		18.6880	18.3383	0.3497	1.87	
		Average	18.8714	18.5190	0.3524	1.86	26
Average of 12 and 12-B					0.3572		24.5
Blank 12-12-B (C.P. HCl)	14.5		19.5891	19.1114	0.4777	2.44	
" " " "	14.5		18.1447	17.6659	0.4788	2.64	
" " " "	14.5		18.3639	17.9077	0.4562	2.48	
" " " "	14.5		18.9834	18.5066	0.4768	2.51	
" " " "	14.5		18.9287	18.4288	0.4999	2.64	
" " " "	14.5		18.9680	18.5024	0.4656	2.45	
		Average	18.8296	18.3538	0.4758	2.53	—
Sample 15 (Crawford) 8-23-39	15.2		16.8811	16.6213	0.2598	1.54	
" " "	15.2		16.9076	16.6521	0.2555	1.51	
" " "	15.2		18.4502	18.1831	0.2671	1.45	
			17.4130	17.1522	0.2608	1.50	43
Sample 15 (Crawford) 8-31-39	15.2		18.5377	18.2760	0.2617	1.41	
" " "	15.2		18.6654	18.3908	0.2746	1.47	
" " "	15.2		18.3411	18.0969	0.2442	1.33	
		Average	18.5147	18.2546	0.2602	1.40	47
Average of 15					0.2605		45
Blank 15 (C.P. HCl)	15.2		19.0300	18.5184	0.5116	2.69	
" " " "	15.2		19.5733	19.0547	0.5186	2.65	
" " " "	15.2		18.5200	18.0251	0.4949	2.67	
" " " "	15.2		19.0408	18.5354	0.5054	2.65	
" " " "	15.2		19.0202	18.5312	0.4890	2.57	
" " " "	15.2		19.5732	19.0660	0.5072	2.59	
		Average	19.1262	18.6218	0.5044	2.64	—

TABLE III

ACID CORROSION TESTS

Metal Strips from an oil well pipe of the Oil Well Supply Company approximately 1" x 7/8" x 3/16" were used. The solutions were not agitated. The experiments were carried out at 85° F., the volume of the acid solution used per test was 50 cc., and the time of the tests was 16 hours.

	% Hydrochloric Acid	Initial Weight (Grams)	Final Weight (Grams)	Loss in Weight (Grams)	% Loss in Weight	% Reduction in Corrosiveness
Sample 5 (Stella Wilcox)	14.8	19.9353	19.3546	0.5807	2.91	
" " " "	14.8	19.0582	18.4846	0.5736	3.01	
" " " "	14.8	18.8018	18.2534	0.5484	2.92	
	Average	19.2651	18.6975	0.5676	2.95	36
Sample 6 (Stella Wilcox)	14.8	19.0060	18.4466	0.5594	2.94	
" " " "	14.8	20.2977	19.6902	0.6075	2.99	
" " " "	14.8	19.3068	18.7338	0.5730	2.97	
	Average	19.5368	18.9569	0.5800	2.97	35
Sample 8 (Stella Wilcox)	14.8	18.9647	18.3767	0.5880	3.10	
" " " "	14.8	19.6200	19.0083	0.6117	3.12	
" " " "	14.8	18.4816	17.8917	0.5899	3.19	
	Average	19.0221	18.4256	0.5965	3.14	32
Average of 5, 6 and 8				0.5814		34
Blank 5-6-8 (C.P. HCl)	14.8	19.5763	18.6750	0.9013	4.60	
" " "	14.8	19.1767	18.2696	0.9071	4.73	
" " "	14.8	19.0253	18.1640	0.8613	4.53	
" " "	14.8	18.8671	18.0217	0.8454	4.48	
" " "	14.8	18.2470	17.3904	0.8566	4.69	
" " "	14.8	18.6431	17.8031	0.8400	4.51	
	Average	18.9226	18.0540	0.8686	4.59	—
Sample 12 (Zahn)	14.5	19.0021	18.4468	0.5553	2.92	
" " "	14.5	19.1705	18.6055	0.5650	2.95	
" " "	14.5	18.4762	17.9037	0.5725	3.10	
	Average	18.8829	18.3187	0.5643	2.99	27
Sample 12-B (Zahn)	14.5	18.2172	17.7005	0.5167	2.84	
" " "	14.5	20.2934	19.7279	0.5655	2.79	
	Average	19.2553	18.7142	0.5411	2.82	31
Average of 12 and 12-B				0.5527		29
Blank 12-12-B (C.P. HCl)	14.5	19.7102	18.8954	0.8148	4.13	
" " "	14.5	19.3836	18.5927	0.7909	4.08	
" " "	14.5	20.3652	19.5444	0.8208	4.03	
" " "	14.5	18.2667	17.5143	0.7524	4.12	
" " "	14.5	19.6882	18.8753	0.8129	4.13	
" " "	14.5	20.5504	19.7218	0.8286	4.03	
	Average	19.6607	18.8573	0.8034	4.09	—
Sample 15 (Crawford) 8-31-39	15.2	19.6722	19.2457	0.4265	2.17	
" " "	15.2	19.1750	18.7457	0.4293	2.24	
" " "	15.2	19.7750	19.3366	0.4384	2.22	
	Average	19.5407	19.1093	0.4314	2.21	54
Sample 15 (Crawford) 8-23-39	15.2	18.4876	18.0425	0.4451	2.41	

	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	
" " "	14.5		18.4762	17.9037	0.5725	3.10	
		Average	18.8829	18.3187	0.5643	2.99	27
Sample 12-B (Zahn)	14.5		18.2172	17.7005	0.5167	2.84	
" " "	14.5		20.2934	19.7279	0.5655	2.79	
		Average	19.2553	18.7142	0.5411	2.82	31
Average of 12 and 12-B					0.5527		29
Blank 12-12-B (C.P. HCl)	14.5		19.7102	18.8954	0.8148	4.13	
" " "	14.5		19.3836	18.5927	0.7909	4.08	
" " "	14.5		20.3652	19.5444	0.8208	4.03	
" " "	14.5		18.2667	17.5143	0.7524	4.12	
" " "	14.5		19.6882	18.8753	0.8129	4.13	
" " "	14.5		20.5504	19.7218	0.8286	4.03	
		Average	19.6607	18.8573	0.8034	4.09	—
Sample 15 (Crawford) 8-31-39	15.2		19.6722	19.2457	0.4265	2.17	
" " "	15.2		19.1750	18.7457	0.4293	2.24	
" " "	15.2		19.7750	19.3366	0.4384	2.22	
		Average	19.5407	19.1093	0.4314	2.21	54
Sample 15 (Crawford) 8-23-39	15.2		18.4876	18.0425	0.4451	2.41	
" " "	15.2		18.2342	17.8040	0.4302	2.36	
" " "	15.2		19.9679	19.5059	0.4620	2.31	
		Average	18.8966	18.4508	0.4458	2.36	51
Average of 15					0.4386		52.5
Blank 15 (C.P. HCl)	15.2		18.8353	17.9192	0.9161	4.86	
" " "	15.2		20.2051	19.2449	0.9602	4.75	
" " "	15.2		19.5647	18.6332	0.9315	4.76	
" " "	15.2		18.4148	17.5202	0.8946	4.86	
" " "	15.2		18.2444	17.3691	0.8753	4.80	
" " "	15.2		19.4536	18.5266	0.9270	4.75	
		Average	19.1196	18.2022	0.9174	4.80	—

TABLE IV
ACID CORROSION TESTS

Metal strips from an oil well pipe of the Atha Supply Company approximately 1" x 7/8" x 3/16" were used. The solutions were not agitated. The experiments were carried out at 85° F., the volume of the acid solution used per test was 50 cc., and the time of the tests was 16 hours.

	% Hydrochloric Acid	Initial Weight (Grams)	Final Weight (Grams)	Loss in Weight (Grams)	% Loss in Weight	% Reduction in Corrosiveness
Sample 5 (Stella Wilcox)	14.8	20.7069	20.2526	0.4543	2.19	
" " " "	14.8	20.7511	20.2998	0.4513	2.17	
" " " "	14.8	20.5949	20.1592	0.4357	2.12	
	Average	20.6843	20.2372	0.4471	2.16	38
Sample 6 (Stella Wilcox)	14.8	20.6017	20.1583	0.4434	2.15	
" " " "	14.8	21.3841	20.9261	0.4580	2.14	
	Average	20.9929	20.5422	0.4507	2.14	39
Sample 8 (Stella Wilcox)	14.8	20.3989	19.8683	0.5306	2.60	
" " " "	14.8	20.6135	20.0934	0.5201	2.52	
" " " "	14.8	20.5046	19.9832	0.5214	2.54	
	Average	20.5057	19.9816	0.5240	2.55	27
Average of 5, 6 and 8				0.4739		35
Blank 5-6-8 (C.P. HCl)	14.8	20.8553	20.1248	0.7305	3.50	
" " "	14.8	20.6635	19.9217	0.7418	3.59	
" " "	14.8	20.8786	20.1619	0.7167	3.43	
" " "	14.8	21.2656	20.5308	0.7348	3.45	
" " "	14.8	20.4314	19.7291	0.7023	3.44	
	Average	20.8189	20.0937	0.7252	3.48	—
Sample 12 (Zahn)	14.5	21.9644	21.4954	0.4690	2.13	
" " "	14.5	21.0874	20.6017	0.4857	2.30	
" " "	14.5	20.6899	20.2377	0.4522	2.19	
	Average	21.2472	20.7783	0.4690	2.21	34
Sample 12-B (Zahn)	14.5	19.6432	19.2835	0.3597	1.83	
" " "	14.5	20.3731	19.9933	0.3798	1.86	
	Average	20.0081	19.6384	0.3698	1.84	45
Average of 12 and 12-B				0.4194		39.5
Blank 12-12-B (C.P. HCl)	14.5	20.8167	20.1260	0.6907	3.32	
" " "	14.5	20.6086	19.9212	0.6874	3.33	
" " "	14.5	20.3016	19.6205	0.6811	3.35	
" " "	14.5	20.2327	19.5626	0.6701	3.31	
" " "	14.5	20.4971	19.8035	0.6936	3.38	
	Average	20.4913	19.8068	0.6846	3.34	—
Sample 15 (Crawford) 8-23-39	15.2	20.5120	20.3674	0.1446	0.70	
" " " "	15.2	20.4339	20.3137	0.1202	0.59	
" " " "	15.2	21.2896	21.1128	0.1768	0.83	
	Average	20.7452	20.5980	0.1472	0.71	81
Sample 15 (Crawford) 8-31-39	15.2	22.6972	22.5202	0.1770	0.78	
" " " "	15.2	20.3798	20.2462	0.1336	0.65	
" " " "	15.2	23.4647	23.2498	0.2149	0.92	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

		Average	21.2472	20.7783	0.4690	2.21	34
Sample 12-B (Zahn)	14.5		19.6432	19.2835	0.3597	1.83	
“ “ “	14.5		20.3731	19.9933	0.3798	1.86	
		Average	20.0081	19.6384	0.3698	1.84	45
Average of 12 and 12-B					0.4194		39.5
Blank 12-12-B (C.P. HCl)	14.5		20.8167	20.1260	0.6907	3.32	
“ “ “	14.5		20.6086	19.9212	0.6874	3.33	
“ “ “	14.5		20.3016	19.6205	0.6811	3.35	
“ “ “	14.5		20.2327	19.5626	0.6701	3.31	
“ “ “	14.5		20.4971	19.8035	0.6936	3.38	
		Average	20.4913	19.8068	0.6846	3.34	—
Sample 15 (Crawford) 8-23-39	15.2		20.5120	20.3674	0.1446	0.70	
“ “ “ “	15.2		20.4339	20.3137	0.1202	0.59	
“ “ “ “	15.2		21.2896	21.1128	0.1768	0.83	
		Average	20.7452	20.5980	0.1472	0.71	81
Sample 15 (Crawford) 8-31-39	15.2		22.6972	22.5202	0.1770	0.78	
“ “ “ “	15.2		20.3798	20.2462	0.1336	0.65	
“ “ “ “	15.2		23.4647	23.2498	0.2149	0.92	
		Average	22.1806	22.0054	0.1752	0.78	79
Average of 15					0.1612		80
Blank 15 (C.P. HCl)	15.2		20.6579	19.8899	0.7680	3.72	
“ “ “	15.2		21.7769	20.9629	0.8140	3.74	
“ “ “	15.2		20.3977	19.6142	0.7835	3.84	
“ “ “	15.2		20.7252	19.9493	0.7759	3.74	
“ “ “	15.2		20.7871	20.0147	0.7724	3.72	
		Average	20.8690	20.0862	0.7828	3.75	—

PLAINTIFF'S EXHIBIT 158

TABLE VII

ACID CORROSION TESTS

Metal strips of strap iron, series D, approximately 1" x 7/8" x 1/8" were used. The solutions were not agitated. The experiments were carried out at 85° F., the volume of the acid solution used per test was 50 cc., and the time of the tests was 16 hours.

	% Hydrochloric Acid		Initial Weight (Grams)	Final Weight (Grams)	Loss in Weight (Grams)	% Loss in Weight	% Reduction in Corrosiveness
Sample N-14-B Diluted to	14.5		14.5279	14.0619	0.4660	3.21	7.2
Sample S-14-B Diluted to	14.5		14.7580	14.2727	0.4853	3.29	4.9
Blank of Diluted N-14-B and S-14-B (C.P. HCl)	14.5		14.6114	14.1134	0.4980	3.41	
"	14.5		14.6136	14.1192	0.4944	3.38	
"	14.5		14.6004	14.0748	0.5256	3.60	
		Average	14.6085	14.1025	0.5060	3.46	—
Sample N-20-B Diluted to	15.1		14.7282	14.2555	0.4727	3.21	
"	15.1		14.4927	14.0221	0.4706	3.25	
		Average	14.6104	14.1388	0.4716	3.23	11.3
Sample S-20-B Diluted to	15.1		14.3950	13.9121	0.4829	3.35	
"	15.1		14.3615	13.8781	0.4834	3.37	
		Average	14.3782	13.8951	0.4832	3.36	7.7
Blank of Diluted N-20-B and S-20-B (C.P. HCl)	15.1		14.4905	13.9644	0.5261	3.63	
"	15.1		14.5299	14.0036	0.5263	3.62	
"	15.1		14.4529	13.9221	0.5308	3.67	
"	15.1		14.4434	13.9173	0.5261	3.64	
		Average	14.4792	13.9518	0.5273	3.64	—

TABLE VIII

ACID CORROSION TESTS

Metal Strips from an oil well pipe of the National Supply Company approximately 1" x ⅞" x 3/16" were used. The solutions were not agitated. The experim s were carried out at 85° F., the volume of the acid solution used per test was 50 cc., and the time of the tests was 16 hours.

	% Hydrochloric Acid	Initial Weight (Grams)	Final Weight (Grams)	Loss in Weight (Grams)	% Loss in Weight	% Reduction in Corrosiveness
Sample N-14-B Diluted to	14.5	18.0529	17.6306	0.4223	2.34	7.5
Sample S-14-B Diluted to	14.5	17.9273	17.4922	0.4351	2.43	4.0
Blank of Diluted N-14-B and S-14-B (C.P. HCl)	14.5	19.5891	19.1114	0.4777	2.44	
"	14.5	18.1447	17.6659	0.4788	2.64	
"	14.5	18.3639	17.9077	0.4562	2.48	
"	14.5	18.9834	18.5066	0.4768	2.51	
"	14.5	18.9287	18.4288	0.4999	2.64	
"	14.5	18.9680	18.5024	0.4656	2.45	
	Average	18.8296	18.3538	0.4758	2.53	—
Sample N-20-B Diluted to	15.1	19.4419	18.9868	0.4551	2.34	
"	15.1	17.9398	17.5163	0.4235	2.36	
	Average	18.6908	18.2516	0.4393	2.35	15.5
Sample S-20-B Diluted to	15.1	19.3011	18.8152	0.4859	2.52	
"	15.1	17.8251	17.3721	0.4530	2.54	
	Average	18.5631	18.0936	0.4694	2.53	9.0
Blank of Diluted N-20-B and S-20-B (C.P. HCl)	15.1	18.6084	18.0928	0.5156	2.77	
"	15.1	18.6948	18.1811	0.5137	2.75	
"	15.1	18.6908	18.1980	0.4928	2.64	
"	15.1	18.8523	18.3351	0.5172	2.74	
"	15.1	18.8956	18.3789	0.5167	2.73	
"	15.1	18.8080	18.2826	0.5254	2.79	
"	15.1	17.9263	17.4172	0.5091	2.84	
"	15.1	17.9937	17.4807	0.5130	2.85	
"	15.1	17.9413	17.4269	0.5144	2.87	
	Average	18.4901	17.9770	0.5131	2.78	—

PLAINTIFF'S EXHIBIT 160

TABLE XI

ANALYSIS MADE OF HALLIBURTON TRUCK ACID SAMPLES

Sample	% Hydro-chloric Acid	Copper p.p.m.	Lead p.p.m.	Iron p.p.m.
5 Stella Wilcox	14.8	2.9	410	480
6 Stella Wilcox	14.8	3.6	420	470
8 Stella Wilcox	14.8	4.2	420	470
Average Stella Wilcox	14.8	3.6	417	473
12 Zahn	14.5	2.7	410	410
12-B Zahn	14.5	3.5	460	350
Average Zahn	14.5	3.1	435	380
15 Crawford 8-23-39	15.2	4.5	48	210
15 Crawford 8-31-39	15.2	5.0	58	210
Average Crawford	15.2	4.8	53	210
Average Metal Content of Stella Wilcox, Zahn and Crawford Samples		3.8	302	354

PLAINTIFF'S EXHIBIT 161

TABLE XII

ANALYSIS MADE OF HALLIBURTON STORAGE TANK ACID SAMPLES

Sample	% Hydrochloric Acid	Copper p.p.m.	Lead p.p.m.	Iron p.p.m.
N-14-B	28.5	1.5	10	27
S-14-B	29.3	1.5	8.7	13
N-20-B	30.3	0.37	5.5	15
S-20-B	30.7	0.56	16	21
Average		0.98	10	19

PLAINTIFF'S EXHIBIT 162

TABLE XIII

ANALYSIS MADE OF DILUTED HALLIBURTON STORAGE TANK ACID SAMPLES

Sample	% Hydrochloric Acid	Copper p.p.m.	Lead p.p.m.	Iron p.p.m.
N-14-B Diluted to	14.5	0.72	4.8	13
S-14-B Diluted to	14.5	0.69	4.0	6.0
N-20-B Diluted to	15.1	0.17	2.6	7.0
S-20-B Diluted to	15.1	0.26	7.3	9.6
Average		0.46	4.7	8.9

PLAINTIFF'S EXHIBIT 163

TABLE XIV

COMPARISON OF THE METAL CONTENT OF THE ZAHN WELL SAMPLES NOS. 12 AND 12-B, AND THE DILUTED STORAGE SAMPLES N-14-B AND S-14-B

Sample	% Hydrochloric Acid	Copper p.p.m.	Lead p.p.m.	Iron p.p.m.
12 Zahn	14.5	2.7	410	410
12-B Zahn	14.5	3.5	460	350
Average	14.5	3.1	435	380
N-14-B Diluted to	14.5	0.72	4.8	13
S-14-B Diluted to	14.5	0.69	4.0	6.0
Average	14.5	0.70	4.4	9.5
The ratio of the average metal content of the Zahn samples to the average metal content of the diluted storage samples N-14-B and S-14-B		4 :1	99 :1	40 :1

PLAINTIFF'S EXHIBIT 164

TABLE XV

COMPARISON OF THE METAL CONTENT OF THE STELLA WILCOX SAMPLES NOS. 5, 6 AND 8, AND THE DILUTED STORAGE SAMPLES N-14-B AND S-14-B

Sample	% Hydro-chloric Acid	Copper p.p.m.	Lead p.p.m.	Iron p.p.m.
5 Stella Wilcox	14.8	2.9	410	480
6 Stella Wilcox	14.8	3.6	420	470
8 Stella Wilcox	14.8	4.2	420	470
Average	14.8	3.6	417	473
N-14-B Diluted to	14.5	0.72	4.8	13
S-14-B Diluted to	14.5	0.69	4.0	6.0
Average	14.5	0.70	4.4	9.5
The ratio of the average metal content of the Stella Wilcox samples to the average metal content of the diluted storage samples N-14-B, and S-14-B		5 : 1	95 : 1	50 : 1

PLAINTIFF'S EXHIBIT 165

TABLE XVI

COMPARISON OF THE METAL CONTENT OF THE CRAWFORD SAMPLES 15, AND THE DILUTED STORAGE SAMPLES N-14-B, S-14-B, N-20-B AND S-20-B.

Sample	% Hydrochloric Acid	Copper p.p.m.	Lead p.p.m.	Iron p.p.m.
15 Crawford 8-23-39	15.2	4.5	48	210
15 Crawford 8-31-39	15.2	5.0	58	210
Average	15.2	4.8	53	210
N-14-B Diluted to	14.5	0.72	4.8	13
S-14-B Diluted to	14.5	0.69	4.0	6.0
N-20-B Diluted to	15.1	0.17	2.6	7.0
S-20-B Diluted to	15.1	0.26	7.3	9.6
Average	...	0.46	4.7	8.9
The ratio of the average metal content of the Crawford samples to the average metal content of the diluted storage samples N-14-B, S-14-B, N-20-B and S-20-B		10 : 1	11 : 1	24 : 1

PLAINTIFF'S EXHIBIT 166

TABLE XVIII

ACID CORROSION TESTS

Acid corrosion tests at 85° F.. using strap iron and 50 cc. of 15.1% C.P. hydrochloric acid solutions containing different amounts of copper, lead, and iron. The solutions were not agitated. The tests required a period of 16 hours.

Solution Number	Copper p.p.m.	Lead p.p.m.	Ferric Iron p.p.m.	Ferrous Iron p.p.m.	% Reduction In Corrosiveness
1	1.0	——	——	——	20
2	3.5	——	——	——	33
3	5.0	——	——	——	37
4	10.0	——	——	——	38
5	40.0	——	——	——	39
6	80.0	——	——	——	40
7	100.0	——	——	——	40
8	——	10	——	——	4
9	——	40	——	——	3
10	——	160	——	——	6
11	——	320	——	——	12
12	——	420	——	——	13
13	——	620	——	——	14
14	——	1000	——	——	15
15	——	——	300	——	1
16	——	——	440	——	3
17	——	——	700	——	4
18	——	——	1000	——	4
19	——	——	——	300	0
20	——	——	——	440	0
21	——	——	——	700	1
22	——	——	——	1000	0
23	3.5	10	——	——	36
24	3.5	40	——	——	38

Plaintiff's Exhibit 166

Solution Number	Copper p.p.m.	Lead p.p.m.	Ferric Iron p.p.m.	Ferrous Iron p.p.m.	% Reduction In Corrosiveness
25	3.5	160	—	—	38
26	3.5	320	—	—	38
27	3.5	420	—	—	38
28	3.5	620	—	—	40
29	3.5	1000	—	—	41
30	3.5	—	300	—	33
31	3.5	—	440	—	34
32	3.5	—	700	—	33
33	3.5	—	1000	—	34
34	3.5	—	—	300	34
35	3.5	—	—	440	34
36	3.5	—	—	700	33
37	3.5	—	—	1000	34
38	1.0	420	—	—	30
39(27)	3.5	420	—	—	38
40	5.0	420	—	—	40
41	10.0	420	—	—	41
42	40.0	420	—	—	42
43	80.0	420	—	—	42
44	100.0	420	—	—	43
45	—	420	300	—	12
46	—	420	440	—	14
47	—	420	700	—	12
48	—	420	1000	—	12
49	—	420	—	300	11
50	—	420	—	440	11
51	—	420	—	700	10
52	—	420	—	1000	9
53	1.0	—	440	—	20
54(31)	3.5	—	440	—	34
55	5.0	—	400	—	38
56	10.0	—	440	—	38
57	40.0	—	440	—	40
58	80.0	—	440	—	38
59	100.0	—	440	—	37

Plaintiff's Exhibit 166

Solution Number	Copper p.p.m.	Lead p.p.m.	Ferric Iron p.p.m.	Ferrous Iron p.p.m.	% Reduction In Corrosiveness
60	—	10	440	—	0
61	—	40	440	—	6
62	—	160	440	—	9
63	—	320	440	—	14
64(46)	—	420	440	—	14
65	—	620	440	—	17
66	—	1000	440	—	17
67	3.5	420	300	—	39
68	3.5	420	440	—	40
69	3.5	420	700	—	38
70	3.5	420	1000	—	38
71	3.5	10	440	—	34
72	3.5	40	440	—	37
73	3.5	160	440	—	36
74	3.5	320	440	—	37
75(68)	3.5	420	440	—	40
76	3.5	620	440	—	40
77	3.5	1000	440	—	40
78	1.0	420	440	—	30
79(68)(75)	3.5	420	440	—	40
80	5.0	420	440	—	39
81	10.0	420	440	—	41
82	40.0	420	440	—	40
83	80.0	420	440	—	42
84	100.0	420	440	—	42
85	3.5	420	...	440	39

PLAINTIFF'S EXHIBIT 167

TABLE XIX

ACID CORROSION TESTS

Acid corrosion tests at 85°F., using strap iron, Series J.
The tests required a period of 16 hours.

Solution Number	Characteristics of Solution: Acid	Added Metals, Parts per million: Copper	Lead	Iron	Reduction in Corrosiveness: 50 cc. of Solution With No Agitation	50 cc. of Solution With Agitation	300 cc. of Solution With Agitation
2	15.1% C.P. HCl	3.5	None	None	33%	44%	63%
26	15.1% C.P. HCl	3.5	320	None	38%	48%	63%
30	15.1% C.P. HCl	3.5	None	300 (ferric)	33%	43%	64%
34	15.1% C.P. HCl	3.5	None	300 (ferrous)	34%	43%	64%
68	15.1% C.P. HCl	3.5	420	440 (ferric)	40%	52%	63%
85	15.1% C.P. HCl	3.5	420	440 (ferrous)	39%	50%	65%

PLAINTIFF'S EXHIBIT 169

DR. BARTELL'S DATA

COPPER, LEAD AND IRON CONTENT IN GRAMS PER 1000 GALLONS OF DEFENDANTS HYDROCHLORIC ACID SAMPLES

	Storage Acids			Truck Acids	
	Sample N-14-B Taken Aug. 18, 1938 Diluted to 14.5% Acid	Sample S-14-B Taken Aug. 18, 1938 Diluted to 14.5% Acid	Average	Stella Wilcox Treated Aug. 5, 1938 14.8% Acid	Zahn Treated Aug. 19, 1938 14.5% Acid
Copper	3.1 gms.	3.0 gms.	3.05 gms.	15 gms.	13 gms.
	0.72 p.p.m.	0.69 p.p.m.	0.70 p.p.m.	3.6 p.p.m.	3.1 p.p.m.
Lead	21 gms.	17 gms.	19 gms.	1700 gms.	1800 gms.
	4.8 p.p.m.	4.0 p.p.m.	4.4 p.p.m.	417 p.p.m.	435 p.p.m.
Iron	56 gms.	26 gms.	41 gms.	1900 gms.	1500 gms.
	13 p.p.m.	6.0 p.p.m.	9.5 p.p.m.	473 p.p.m.	380 p.p.m.
	Sample N-20-B Taken Dec. 6, 1938 Diluted to 15.1% Acid	Sample S-20-B Taken Dec. 6, 1938 Diluted to 15.1% Acid	Average	Crawford Treated Sept. 10, 1938 15.2% Acid	
Copper	0.75 gms.	1.1 gms.	0.92 gms.	20 gms.	
	0.17 p.p.m.	0.26 p.p.m.	0.21 p.p.m.	4.8 p.p.m.	
Lead	11 gms.	32 gms.	21 gms.	220 gms.	
	2.6 p.p.m.	7.3 p.p.m.	5.0 p.p.m.	53 p.p.m.	
Iron	30 gms.	42 gms.	36 gms.	860 gms.	
	7.0 p.p.m.	9.6 p.p.m.	8.3 p.p.m.	210 p.p.m.	

No storage acid purchased by defendant between July 24, 1938 and August 27, 1938.

PLAINTIFF'S EXHIBIT 171

BARTELL TABLE X

PERCENTAGE REDUCTION IN CORROSIVENESS OF SOME OF THE GREBE AND SANFORD MATERIALS

The percentages of reduction in corrosiveness were calculated from acid corrosion tests at 85 F., using strap iron Series L, and 50 cc., of acid solutions. The tests required a period of 16 hours. The solutions were not agitated.

Material	% Reduction in Corrosiveness
Saturated Solution of Acridine in 15.1% HCl	41
1% Solution of Aniline in 15.1% HCl	34
3%	60
5%	67
1% Solution of Pyridine in 15.1% HCl	47
3%	60
5%	65
1% Solution of Quinoline in 15.1% HCl	84
3%	84
5%	84

PLAINTIFF'S EXHIBIT 172

HCl ACID RECEIVED BY DEFENDANT AT MT. PLEASANT, MICH., STATION

Date	Amount	Source
April 23, 1938	3,976 gals	Pennsylvania Salt Co.
May 2, 1938	3,914 "	" " "
May 3, 1938	3,945 "	" " "
May 21, 1938	6,075 "	General Chemical Co.
May 23, 1938	5,982 "	" " "
June 15, 1938	5,993 "	" " "
June 15, 1938	7,824 "	" " "
July 24, 1938	6,013 "	" " "

August 2, 1938—Wilcox Well, Samples Nos. 1 and 2. From Halliburton's steel transport tank at well.

August 5, 1938—Wilcox Well, Samples Nos. 5, 6, and 8. From Halliburton's steel transport tank at well.

STORAGE SAMPLES

August 18, 1938, Nos. N-14-B and S-14-B. From Halliburton's wooden storage tanks.

August 19, 1938—Zahn Well, Samples Nos. 12 and 12-B. From Halliburton's steel transport tank at well.

ACID RECEIVED BY DEFENDANT

August 27, 1938 5,938 gals. General Chemical Co.

September 10, 1938—Crawford Well, Sample No. 15 and a second No. 15. From Halliburton's steel transport tank at well.

ACID RECEIVED BY DEFENDANT

October 17, 1938 7,866 gals. General Chemical Co.

STORAGE SAMPLES

December 6, 1938, Nos. N-20-B and S-20-B.
From Halliburton's wooden storage tanks.

April 24, 1939—Knight Well,
From Halliburton's steel transport tank at well.

STORAGE SAMPLES

April 26, 1939, Nos. N-23 and S-23.
From Halliburton's wooden storage tanks.

(PLAINTIFF'S EXHIBIT 173-A)

Acid Sample	Composition of Acid %HCl by Wt.	Concentration in p.p.m. Iron	Lead	Copper	Per Cent Corrosiveness Reduced
1	15.0	0	0	0	100
2	"	473	242	2.14	59.7
3	"	473	242	3.72	70.0
4	"	473	510	1.86	62.8
5	"	473	510	4.18	71.4
6	"	1430	204	1.86	61.1
7	"	1440	530	3.44	70.5

DISCUSSION OF RESULTS AND CONCLUSIONS

1. When iron, copper and lead are dissolved in 15% hydrochloric acid, in the concentrations studied in this work, the corrosiveness of the acid is greatly reduced. The metal contacting acids studied attack the test specimens with 60-70% reduction in corrosiveness when compared to metal free acid.

(PLAINTIFF'S EXHIBIT 173-B)

2. Comparison of the results obtained in tests No. 2 and No. 6 in which the iron content alone differed to any great extent, and also in tests No. 5 and No. 7, shows that increasing the iron from approximately 500 p.p.m. to a value of approximately 1500 did not appreciably change the rate of attack of the 15% hydrochloric acid upon the oil well tubing.

Acid Sample No.	Metallic Content of Acid p.p.m.			Per Cent Corrosiveness Reduced
	Iron	Lead	Copper	
2	473	242	2.14	59.7
6	1430	204	1.86	61.1
5	473	510	4.18	71.4
7	1440	530	3.44	70.5

(PLAINTIFF'S EXHIBIT 173-C)

3. Increasing the lead content of the acid from 242 p.p.m. to 510 p.p.m., and keeping the iron and copper contents substantially constant, reduces slightly the rate of attack of the 15% acid on the oil well tubing, i.e., increases the per cent corrosiveness reduced.

Acid Sample No.	Metallic Content of Acid p.p.m.			Per Cent Corrosiveness Reduced
	Iron	Lead	Copper	
2	473	242	2.14	59.7
4	473	510	1.86	62.8

(PLAINTIFF'S EXHIBIT 173-D)

4. Keeping iron and lead concentrations constant, and increasing the copper content from approximately 2 to 4 parts per million, reduced the corrosiveness of the 15% hydrochloric acid upon the oil well tubing.

Acid Sample No.	Metallic Content of Acid p.p.m. Iron	Lead	Copper	Per Cent Corrosiveness Reduced
2	473	242	2.14	59.7
3	473	242	3.72	70.0

D. Large Scale Tubing Tests

General Procedure

In large scale oil well tubing tests, 15% hydrochloric acid was flowed by gravity for three hours, through 112 feet of 1¼" oil well tubing at a rate of one gallon per minute. The rate of attack of the acid upon the oil well tubing was found by analytical determination of the iron content of the acid entering the tubing and of the acid leaving the tubing during the test.

Details of Equipment

I. Stoneware Crock—

A 200 gallon stoneware crock, having a stoneware spigot in the side close to the bottom, was purchased from M. G. Knight and Company of Akron, Ohio. This crock was thoroughly washed with water and 15% hydrochloric acid before each batch of acid was prepared.

A plate glass cover was obtained to prevent dust or dirt from falling into the acid in the crock during runs. A photograph of this crock is marked Figure I, page 33.

II. Oil Well Tubing Used—

The 1¼" oil well tubing from the Oil Well Supply Co., previously described was employed in these tests. Five full lengths of this tubing were connected together with couplings provided by the Oil Well Supply Co., and by the elbow which we fabricated from one length of the 1¼" oil well tubing, as described previously.

The tubing used, was given the same cleaning procedure as used in preparing the laboratory test specimens, with the exception that the outside of the tubes were not wirebrushed and the drying was conducted by passing warm air thru the tubing instead of drying in an oven.

Figure 2, page 34, shows the acid crock connected to the tubing system.

III. Hydrogen Vent Tube—

A 1" pyrex glass tube (x) was connected to the spigot in the stoneware crock, by means of a short section of pure gum rubber tubing. The lower end of this glass tube was connected to the upper end of the tubing system at Y, using a rubber stopper. All rubber stoppers and connecting tubing were soaked for two days in 15% hydrochloric acid before use.

The upper end of the glass tube (x) permits the escape of bubbles because it is open and vented into the top of the crock. This glass tube (x) permits the escape of bubbles of hydrogen gas during a run, which are produced when hydrochloric acid reacts upon steel. We were thus assured that tubing system would not become filled with hydrogen gas, which would have greatly reduced the area of contact between the acid and the inside of the tubing.

IV. Control of Rate of Flow of Acid in Tubing—

In Figure 3, page 35, is shown the lower end of the oil well tubing system and the calibrated orifice bottle (P) used to measure the rate of flow of the acid leaving the tub-

ing. A rubber stopper was inserted into the open end of the lower length of oil well tubing. A 1" pyrex glass tube running thru this stopper and connected to a short section of pure gum rubber tubing, carried the acid leaving the tubing into the open top of the calibrated orifice bottle (P).

By means of an adjustable screw clamp (S) on the rubber tubing, the rate of flow of acid out of the tubing could be varied. The orifice bottle (P) indicated the rate of flow of the acid. A short section of glass tubing (N) in the stopper in the lower opening of this bottle, was used as the discharge orifice. If the level of hydrochloric acid in the bottle was maintained at the calibration mark (T), exactly one gallon of acid was discharged from the orifice per minute. By means of the screw clamp (S) the rate of flow of acid from the tubing was adjusted so the level in the bottle was maintained at the mark (T), thus keeping the rate of discharge during a run constant at one gallon per minute.

V. Acid Used—

The acid employed in these tests was commercial hydrochloric acid purchased in glass carboys from the Grasselli division of the du Pont Co., and is manufactured in their Cleveland plant. Analyses of various samples of this acid showed low copper, iron and lead contents This acid was diluted in the stoneware crock, to 15% hydrochloric acid content by adding Cleveland city tap water.

In several of the tests to be described, ferrous chloride, lead chloride and copper chloride were added to increase the metal content of the diluted acid, to desired values. In all cases, the metal contents of such batches of acid were determined by chemical analysis of the prepared solutions.

VI. Large Scale Test Data—

Two separate sets of oil well tubing were used in the large scale tests. All Series 1 tests, designated 1A, 1AA,

and 1B were made with one set of oil well tubing, with each tube and fitting in exactly the same position for each of these runs.

All series 2 tests, designated 2A, 2B, 2C and 2D, were made with an entirely different set of tubes and fittings. Each tube and fitting occupied the same position in the tubing assembly in each of these Series 2 runs. Tables I, II, III, IV, V, VI, VII, VIII, give the data obtained and calculated results in each of the large scale tests.

Explanation of Tables

In Table I, page 25, data for run No. 1A is shown. In the second column of the table a general description of the run conditions is given. In the third column is recorded the total volume of acid that has passed through the system at the time when acid samples were taken. Under the heading "Samples Taken at Inlet" are listed the samples taken of the acid leaving the crock and their composition as determined by chemical analysis. In Run 1A, an acid sample was taken from the crock at the start of the run, and a second sample after 134.5 gallons of acid had run through the tubing. The average iron content of these two samples is shown in the next column as 9.3 p.p.m.

Under the general heading "Samples Taken at Outlet," are tabulated the individual samples of acid taken at the outlet from the tubing system, how these samples were combined for analysis and the analysis of the combined samples. Thus sample 1 out was taken when 27.5 gallons of acid had passed through tubing. Sample 2 out, after 55.5 gallons total had passed thru. Samples 1 out, 2 out and 3 out were then combined in proper proportion, and the composite or average sample was analyzed for its iron content, shown to be 1135 parts per million. The high iron content shown for the "Initial Out" sample is due to the rapid dissolution of any free iron particles that may be clinging to the interior of the pipe at the start of the runs.

Calculation of Weight of Iron Dissolved From The Tubing During The Run

In the last column of the Tables I—VIII, pages 25-32, are given the grams of iron dissolved from the oil well tubing during the entire test run. In Run 1A this amounted to 1043 grams of iron and was calculated as follows:

In the accompanying table, page 1733, for the calculation of the iron dissolved from the tubing in Run 1A, the first column gives the number of gallons of acid thru the tubing. The second gives the number of gallons of acid which are represented by the analyzed sample. The third and fourth columns give the iron analysis of the inlet and exit acids in milligrams per cubic centimeter. Parts per million were converted to milligrams per cubic centimeter as follows:

$$\text{mg/cc} = \frac{\text{sp gr. x 1000 x p.p.m}}{}$$

$$\text{mg/cc} = \frac{1.0726 \text{ x p.p.m}}{1.000}$$

e.g.

$$\text{mg Fe/cc} = \frac{1.0726 \text{ x } 9.3}{10^3}$$

$$\text{mg Fe/cc} = 0{,}01$$

The fifth column gives the change in iron concentration of the exit acid over the inlet acid for each period. The last column gives the grams of iron which have been dissolved by the number of gallons of acid in column two. This was calculated as follows:

(Plaintiff's Exhibit 173-D)

$$\frac{\text{The Increase in conc. of iron in mg/cc x cubic centimeters of acid thru tubing}}{10{,}000} = \text{grams fe increase in acid}$$

Since 1 gallon = 3785 cubic centimeters, the calculation would be:

(1) $$\frac{1.21 \times 76.5 \times 3785}{1000} = 350 \text{ grams}$$

(2) $$\frac{1.54 \times 58.0 \times 3785}{1000} = 338 \text{ grams}$$

(3) $$\frac{1.50 \times 62.6 \times 3785}{1000} = 355 \text{ grams}$$

Total increase of iron in acid = 1043 grams

CALCULATION OF WEIGHT OF IRON DISSOLVED FROM OIL WELL TUBING DURING RUN 1A

Gallons of Acid Thru Tubing	Gallons of Acid Thru Tubing Between Samples	mg Fe/cc Inlet Acid	mg Fe/cc Exit Acid	Increase in Conc. mg Fe/cc	Grams Iron dissolved from Tubing
76.5	76.5	0.01	1.22	1.21	350
134.5	58	0.01	1.55	1.54	338
197.1	62.6	0.01	1.51	1.50	355
					1043 Total grams

PLAINTIFF'S EXHIBIT 176

PRUTTON TABLE I

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
1A	15% HCl Acid directly from stoneware crock thru tubing. Temperature 85° F. and rate 1 gal. per minute. Series 1 tubing.	0	Initial Crock		Initial Out	2240	
		27.5			1		
		55.5			2	1135	
		76.5		9.3	3		
		95.5			4		
		114.5			5	1450	
		134.5	Crock 2		6		
		152.5			7		
		171.5			8	1405	
		191.5			9		
		197.1			10		

1043

PLAINTIFF'S EXHIBIT 177

PRUTTON TABLE II

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	ppm Fe	Sample No.	ppm Fe	
1AA	15% HCl acid directly from stoneware crock thru tubing. One gal. per min. at 85° F. Series 1 Tubing	0	Initial Crock		Initial	3540	
		25			1		
		47			2	1180	
		67			3		
		86		4	4		
		105	Crock 2		5	1263	
		125			6		
		146			7		
		168			8	1218	
		183.2			9		
		189.98			10		
							943

PLAINTIFF'S EXHIBIT 178

PRUTTON TABLE III

	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
A	15% HCl acid directly from a stoneware crock to series 2 tubing; temperature 85° F. and rate 1 gal. per minute	0	Initial Crock		Initial Out	3580	
		27			1		
		47			2	1292	
		66		9.3	3		
		85			4		
		104			5	1357	
		126	Crock 2		6		
		144			7		
		159			8	967	
		176			9		
		188.3			10		919

PLAINTIFF'S EXHIBIT 179

PRUTTON TABLE IV

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
2C	Acid directly from stoneware crock thru series 2 tubing 1 gallon per minute at 85° F.	0	Crock	7.0	Initial Out	1330	
		27			1	1143	
		46			2		
		64			3		
		84			4	1088	
		102			5		
		121			6		
		142			7	1070	
		161			8		
		178			9		
		178					791

PLAINTIFF'S EXHIBIT 180

PRUTTON TABLE V

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
1B	Acid directly from stoneware crock through series 1 tubing. 1 gal. per minute and 85° F. Acid was treated with $CuCl_2$, $PbCl_2$, $FeCl_2$	0	Initial Crock	1682	Initial Out	3250	
		25			1	1990	
		45			2		
		63			3		
	Average Analysis	86			4	2010	
	ppm Pb / ppm Cu	102			5		
	Inlet 390 / 2.79						
		123.5	Crock 2		6		
		145			7	1942	
		177			8		
		184			9		
		201			10		238

PLAINTIFF'S EXHIBIT 181

PRUTTON TABLE VI

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Exit		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
2B	Acid directly from stoneware crock through series 2 tubing. 1 gal. per minute at 85° F. Acid was treated with $CuCl_2$, $PbCl_2$, $FeCl_2$. Average Analysis ppm Pb ppm Cu Inlet 316 3.07	0	Initial Crock		Initial End	5970	
		25.5			1		
		44			2	2750	
		61.5			3		
		83		2315	4		
		101.5	Crock 2		5	2770	
		122.5			6		
		143			7		
		162			8	2610	
		179.5			9		
		186.3			10		
							299.8

PLAINTIFF'S EXHIBIT 182

PRUTTON TABLE VII

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Exit		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
2D	Acid directly from stoneware crock thru series 2 tubing. 1 gal. per min. and 85° F. Acid was treated with $PbCl_2$, $FeCl_2$ and $CuCl_2$.	0	Crock	418	Initial Out	2295	
		25.6			1		
		46.3			2	688	
		62.7			3		
	Average Analysis	82.9			4		
	ppm Pb / ppm Cu	101.9			5	697	
	Inlet 455 / 3.71	124.3			6		
		141.3			7		
		163.7			8	669	
		179.3			9		
							195

PLAINTIFF'S EXHIBIT 183

PRUTTON TABLE VIII

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	pp m Fe	Sample No.	pp m Fe	
2E	4.465N HCl directly from stoneware crock thru series 2 tubing. 1 gal. per minute and 85° F. Acid was treated with $PbCl_2$, $FeCl_2$, and Cu_2Cl_2.	0	Crock 1		Initial Out		
		23			1		
		45			2	550	
		63.5		382	3		
		80.5			4		
		103.2			5	508	
		120.5	Crock 2		6		
	Average Analysis	142.5			7		
	ppm Pb ppm Cu	165.5			8	433	
	Inlet 340 3.8						
		186.0			9		
		191.5					101.4

PLAINTIFF'S EXHIBIT 184

CORROSION OF OIL WELL TUBING BY 15% HYDROCHLORIC ACID

C. F. Prutton
June 20, 1941

Object

To determine the effect of dissolved iron, lead and copper in reducing the rate of attack of 15% hydrochloric acid upon oil well tubing.

Summary and Conclusions

1. Copper and lead added in low concentrations to 15% hydrochloric acid greatly reduce the rate of attack of the acid upon oil well tubing.

2. In the tests conducted, commercial hydrochloric acid diluted to 15% concentration, attacked the oil well tubing at the rate of from 70 to 80 grams of iron dissolved per square meter of surface per hour of contact or 0.344 to 0.393 pounds per square foot per day. The rate of attack of this same acid, to which was added metals to correspond to the composition of Halliburton truck samples as reported to us by Mr. Rebbeck, showed a rate of attack of only 20 to 30 grams of iron dissolved per square meter of steel surface per hour of contact or 0.098 to 0.147 pounds per square foot per day.

Outline of Work

Mr. J. W. Rebbeck of the Dow Chemical Co. supplied the composition of acid used by Halliburton in acidizing oil wells in Michigan. He reported the acid samples taken from Halliburton truck tanks contained approximately 380 parts per million iron, 340 parts per million lead, and 3.8 parts per million copper.

In this work we have determined the rate of attack of

fifteen per cent hydrochloric acid upon oil well tubing, and the rate of attack of this same acid, to which have been added the amounts of metal Mr. Rebbeck has reported in Halliburton samples.

Laboratory tests to determine the rate of attack of such acids upon oil well tubing were made, using small sections of oil well tubing. Large scale tests were then made, in which a large volume of the acid was flowed through a 112 feet long section of oil well tubing, to approximate conditions occurring in the acidizing of an oil well.

The oil well tubing used for all of these tests was obtained from the Oil Well Supply Co. of Pittsburgh, Penna., and has the following specifications:

1¼" Oil Well Tubing, external upset, range 1, T and C, 2.40 lbs.

Couplings were supplied with the tubing.

Each length of tubing and coupling was given a permanent marking.

To set up the large scale setup an elbow and tee were required. Each was made by welding the threaded ends cut from one length of the oil well tubing.

A. Laboratory Tests

The following procedure was employed to determine in a small scale laboratory test, the rate at which hydrochloric acid dissolved the oil well tubing.

1. Preparation of Tubing Samples:

One length of the 1¼" oil well tubing was employed to prepare samples for the laboratory tests. Sections slightly over one inch in length were cut from this tubing. These samples were then given the following treatments before use in the test.

1. Washed thoroughly with a 50-50 mixture of benzene and acetone to remove oil.
2. Immersed in 15% C. P. Hydrochloric acid for one hour.

3. Rinsed thoroughly in water.
4. Dried in oven at 103° C. for few minutes.
5. Ends of sample faced off in lathe, avoiding oil and handling, to exactly one inch length.
6. Inside and outside sample brushed with clean steel brush.
7. Rinsed thoroughly in acetone.
8. Dried for several minutes at 105° C. in oven.
9. Cooled in desiccator and stored until start of test.

B. Test Procedure:

(a) The acid to be tested was placed in a 2000 cc. wide mouth glass bottle. The volume of acid used was 1360 cubic centimeters. The bottle containing the acid was placed in a constant temperature bath, kept at 30° + or — .05° C., for thirty minutes before starting the test.

(b) A one inch sample of the oil well tubing, which had been prepared as previously described, was accurately weighed. This sample was then suspended on a glass hook in the hydrochloric acid contained in the test bottle. The glass hook was fastened into the plastic top of the test bottle. The sample was maintained in the center of the acid contents of the test bottle, at an angle of 45° from the vertical, by this glass hook.

(c) At the end of exactly three hours, the sample was removed, washed thoroughly with distilled water, then with acetone, dried in the oven at 105° C. for several minutes, cooled in a desiccator and then accurately weighed.

(d) Calculations of Results: Results of this test were expressed in *Grams of Steel Dissolved per Square Meter of Area per Hour of Acid Contact.*

$$\frac{\text{Loss in Weight of Tubing in Grams x 10,000}}{\text{Area of Tubing in Square Centimeters x 3}} = \text{Grams Steel Dissolved/Meter}^2\text{/Hour}$$

This was converted to "pounds of steel dissolved per square foot of area per day of contact."

(e) The "Per cent Corrosiveness Reduced" was calculated from: Per cent Corrosiveness Reduced=

$$\frac{\text{Grams/M}^2\text{/hr dissolved by chem. pure acid—gm}^2\text{/m}^2\text{/hr dissolved by sample acids x 100}}{\text{gm/m}^2\text{/hr dissolved by C. P. acid}}$$

C. Laboratory Test Results:

Chemically pure hydrochloric acid, obtained from the Grasselli Division of the DuPont Co., was diluted to a concentration of 15% hydrochloric by weight, using distilled water.

Tests were made upon this diluted C. P. acid, and upon the samples of this same acid to which definite amounts of iron, lead and copper chlorides had been added. The various concentrations of iron, lead and copper chlorides used in the different samples tested, covered the range of metal compositions reported to us by Mr. J. W. Rebbeck, as having been found in various samples of acid obtained from Halliburton truck tanks and used in the acidizing of oil wells in Michigan.

Reagent-grade Baker and Adamson ferrous chloride, lead chloride and cupric chloride were used to prepare the acid samples for testing. In each prepared acid solution, the exact content of iron, lead and copper was determined by exact chemical analysis before using the acid in the test.

PLAINTIFF'S EXHIBIT 185

PRUTTON TABLE IX

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	ppm Fe	Sample No.	ppm Fe	
1M	Menaul Method Acid and Special tank for 6 hrs. and 33 min. at 85° F. Rate one gal. per min. Series 1 tubing	0	Initial Crock				
		0	Initial Tank	1106	Initial	2130	
		28.5	T-1		1		
		48.5	T-2	1200	2	1570	
	Average Analysis	67.	T-3		3		
	ppm Pb ppm Cu	86.5	T-4		4		
	Inlet 362 4.3						
		106.5	T-5	1340	5	1757	
		123.5	T-6		6		
		143.5	T-7		7		
		163.5	T-8		8	2000	
		182.5	T-9	1590	9		
		198.2	T-10		10		

Plaintiff's Exhibit 185

PRUTTON TABLE X

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Outlet		Total Grams Increase Fe in Acid
			Sample No.	ppm Fe	Sample No.	ppm Fe	
1N	Menaul Method	0	Initial Crock	16.7			
	No wire connected.						
	Temperature 85° F.	0	Initial Tank		Initial Out	3465	
	and rate 1 gal. per minute. Acid in	28.5	T-1		1		
	special tank for 6¼ hours.	48	T-2	1450	2	1830	
	Series 1 tubing.	67	T-3		3		
	Average Analysis	84	T-4		4		
	ppm Pb / ppm Cu	105	T-5	1672	5	2155	
	Inlet 158 / 3.25						
		125	T-6		6		
		142.5	T-7		7		
		160.5	T-8	1830	8	2266	
		181.5	T-9		9		
		187.8			10		
							330

Plaintiff's Exhibit 185

PRUTTON TABLE XI

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet		Samples Taken At Exit		Total Grams Increase Fe in Acid
			Sample No.	ppm Fe	Sample No.	ppm Fe	
2M	Menaul Method. Temperature 85° F. and rate 1 gal. per min. Acid in special tank for seven hours. Series 2 tubing. Average Analysis ppm Pb ppm Cu Inlet 291 2.88	0	Crock Tank				
		0	Initial	1560	Initial Out	3140	
		29	T-1		1		
		48	T-2	1785	2	2130	
		67	T-3		3		
		88	T-4		4		
		108	T-5	2000	5	2370	
		127	T-6		6		
		144.5	T-7		7		
		164	T-8	2285	8	2610	
		184	T-9		9		
		187.75			10		
							265.5

Plaintiff's Exhibit 185

PRUTTON TABLE XII

Run	Conditions	Gallons of Acid Thru Tubing Between Samples	Samples Taken At Inlet: Sample No.	Samples Taken At Inlet: ppm Fe	Samples Taken At Exit: Sample No.	Samples Taken At Exit: ppm Fe	Total Grams Increase Fe in Acid
2N	Menaul Method Acid in Special Tank for 6 hrs. and 30 min. at 85° F. Rate one gal. per min. Wire Disconnected. Series 2 Tubing	0	Initial Crock				
		0	Initial Tank	680	Initial	323	
		28.8	T-1	790	1	1022	
		47	T-2		2		
		68	T-3		3		
	Average Analysis: ppm Pb / ppm Cu						
	Inlet 247 / 2.32	88.5	T-4	920	4	1209	
		106	T-5		5		
		127	T-6		6		
		144.4	T-7	1070	7	1320	
		163	T-8		8		
		181.5	T-9		9		
		187.8			10		
							195.7

PLAINTIFF'S EXHIBIT 192

HISTORY OF OIL DEVELOPMENT IN LIMESTONE FORMATIONS PRIOR TO 1932

OHIO

I. First Limestone fields—

Fields	County	Date of Discovery
(a) Lima—Indiana	N.W. Ohio	1885
(b) Newberg	Cuyahoga	Circa—1915

II. Approximate number of limestone fields producing oil or gas prior to 1932, 10.

III. Approximate number of Companies operating in State prior to 1932—no record.

Names of some companies known to have operated in State prior to 1932: Pure Oil Co., Gordon Oil Co., Bell & Scholl, East Ohio Gas Co., Ohio Fuel Supply Co., Sun Oil Co., Ohio Oil Co., Preston Oil Co., Lupher Drilling Co., Stahl Drilling Co., Murry B. Chidester, Carl B. Schwing, Gulf Oil Corporation, Hope Natural Gas Co.

INDIANA

I. First Limestone Fields—

Fields	County	Date of Discovery
(a) Greensburg	Decatur	1893
(b) Riley	Vigo	1906
(c) Shelburn-Graysville	Sullivan	1911
(d) Trenton	Many	1886

II. Approximate Number of Limestone Fields Producing Oil Prior to 1932, 11.

III. Approximate Number of Companies Operating in State Prior to 1932, 4. Names of Companies: Siosi Oil & Gas Co., Big Four Oil & Gas Co., Ohio Oil Co., Scott Oil Co.

KANSAS

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Lyons	Rice	1888
(b) Vernon (north)	Sumner	1915
(c) Augusta (north)	Butler	1914
(d) Eldorado	Butler	1917
(e) Winfield	Cowley	1914
(f) Dexter	Cowley	1903
(g) Fairport	Russell	1923

II. Approximate number of Limestone Fields Producing Oil or Gas Prior to 1932, 78.

III. Approximate Number of Companies Operating in State Prior to 1932, 48. Names of Companies: Superior Oil Co., Skelley, Slick Pryor & Lockhart, Magnolia, Sinclair, Empire Oil & Refining, Ohio Oil Co., National Refining Co., Phillips Petroleum Co., Cox & Mcginnis, Stanolind Oil & Gas Co., Deep Rock, Texas, Pure Oil Co., Alf M. Landon, Continental, I. T. I. O., Lew Wentz Oil Corp., Shell Oil Co., Gulf Oil Corp., Amerada Petroleum Co., Barnsdall Oil Co., Dickey Oil Co., Gled Oil & Gas Co., Hartman & Blair, Houston Oil Co., Olsen Oil Co., Wilcox Oil & Gas Co., Derby Oil Co., Lario Oil & Gas Co., Ramsey et al., Plains Oil Co., Noble Oil Co., Central Petroleum Co., Twin Drilling Co., J. C. Shaffer, Transwestern Oil Co., Smokey Hill Oil Co., Maybee Consolidated Oil Corp., Vickers Petroleum Co., Champlin Refining Co., British American Oil Producing Co., Tom Palmer, Sunray Oil Co., Barbara Oil Co., Watchorn Oil Co., Helmerich & Payne Inc., T. M. Deal.

MICHIGAN

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Port Huron	St. Clair	1898
(b) Hart	Oceana	1932
(c) Leaton	Isabella	1929
(d) Muskegon	Muskegon	1927
(e) Mt. Pleasant	Midland-Isabella	1928
(f) Porter	Midland	1931

II. Approximate Number of Limestone Fields Producing Oil or Gas Prior to 1932, 8.

III. Approximate Number of Companies Operating in the State Prior to 1932, 10. Names of Companies: Pure Oil Co., Stanolind Oil & Gas Co., Ohio Producing & Refining Co., Johnson Oil & Refining Co., Wittmer Oil & Gas Co., Nollem Oil & Gas Co., Chartiers Oil Co., Sun Oil Co., Bell Oil & Gas Co., Gordon Oil Co.

OKLAHOMA

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Cleveland	Pawnee	1904
(b) Jennings	Pawnee	1916
(c) Yale-Quay	Payne	1914
(d) Boynton	Muskogee	1914
(e) Henrietta	Okmulgee	1910
(f) Bixby	Tulsa	1916
(g) Broken Arrow	Tulsa	1901
(h) Jenks	Tulsa	1901
(i) Bristow	Creek	1916
(j) Cushing	Creek	1912
(k) Braman	Kay	1924
(l) Oklahoma City	Oklahoma	1928
(m) Barnsdall	Osage	1916
(n) Drumright	Creek	1912
(o) Wetumka	Hughes	1923

II. Approximate number of limestone fields producing oil or gas prior to 1932, 109.

III. Approximate number of companies operating in State prior to 1932, 28. Names of Companies: Pure Oil Co., Shell Oil Co., Gulf Oil Co., Mid-Continent Oil Co., Magnolia Petroleum Co., Amerada Petroleum Co., Skelly Oil Co., Barnsdall Oil Co., Sun Oil Co., Ohio Oil Co., Atlantic Oil Refg. Co., Carter Oil Co., Stanolind Oil & Gas Co., Sinclair Prairie Oil Co., Tidewater Associated Oil Co., Deep Rock Oil Co., Phillips Petroleum Co., Continental Oil Co., Champlin Oil & Refg. Co., Cities Service Oil Co., I. T. I. O. Co., Sunray Oil Co., British American Oil Producing Co., Denver Producing & Refg. Co., Bay Oil Co., Alf M. Landon, Darby Pet. Co., Gypsy Oil Co., Superior Oil Co.

TEXAS

I. First Limestone Fields—

Field	County	Date of Discovery
	District—West Texas	
(a) Gulf-McElroy	Crane, Upton	1926
(b) Sand Hills	Crane	1930
(c) World-Powell	Crockett	1926
(d) Iatan-Denman	Howard	1925
(e) Westbrook	Mitchell	1921
(f) Big Lake	Reagan	1923
(g) McCamey	Upton-Crane	1925
	District—East Central Texas	
(h) Bosque	McClennan	1902
(i) Panola	Panola	1921
(j) Waskom	Harrison	1924
	District—North Central Texas	
(k) Ranger	Eastland	1918
(l) Breckenridge	Stephens	1916
(m) Noodle Creek	Jones	1926

	District—Panhandle of Texas	
(n) Carson	Carson	1921
(o) Hutchinson	Hutchinson	1922
(p) Moore	Moore	1926
(q) Potter	Potter	1919
	District—South Texas	
(r) Luling	Coldwell-Guadalupe	1921
(s) Salt Flats	Coldwell	1928
(t) Dale	Coldwell	1927
(u) Darst Creek	Guadalupe	1928

II. Approximate number of limestone fields producing oil or gas prior to 1932.

District	Number
(a) West Texas	22
(b) East Central Texas	6
(c) North Central Texas	10
(d) South Central Texas	9
(e) Panhandle of Texas	7
Total	54

III. Approximate number of Companies operating in State prior to 1932.

District	Number
West Texas	50
East Central Texas	5
North Central Texas	17
South Central Texas	39
Panhandle of Texas	23
Total	134

Names of Companies

District—West Texas

Gulf, Humble, Tidewater, Magnolia, Sinclair-Prairie, Phillips, Texas Co., Shell Oil Co., Cities Service Oil Co., Barnsdall Oil Co., Stanolind Oil and Gas Co.

District—East Central Texas

United Gas Co., Texas Co., Natural Gas Production Co., Arkansas Fuel Oil Co., D. Thompson Drilling Co., Nick Babare.

District—North Central Texas

Magnolia, Lone Star Gas Co., Gulf Oil Corp., Sinclair Prairie, Texas Co., Humble Oil and Refg., Shell Oil Co., Phillips Petroleum Co.

District—South Central Texas

Sun Oil Co., Philtop Oil and Gas Co., McAlester Fuel Co., Magnolia Pet. Co., Rio Bravo Oil Co., Gulf Oil Corp., Empire Oil & Gas Co., Cities Service Oil Co., Texas Co., Forest Development Co.

District—Panhandle of Texas

Barnsdall Oil Co., British American Oil Prod. Co., Cities Service Oil Co., Gulf Oil Corp., Phillips Pet. Co., Pure Oil Company, Ohio Oil Co., Northern Natural Gas Co., Panhandle Eastern Gas Co., Magnolia Pet Co., Continental Oil Co., Stanolind Oil & Gas Co., Skelly Oil Co., Sinclair Prairie Oil Co.

KENTUCKY

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Big Sinking	Lee, Estell	1917
(b) Irvine	Estell, Powell	1915
(c) Campton	Wolf	1903
(d) Bowling Green	Warren, Allen	1918

II. Approximate number of limestone fields producing oil and gas prior to 1932, 8.

III. Approximate number of companies operating in state prior to 1932, 7. Names of Companies: Texas Co., South Penn. Oil Co., Gulf Oil Co., Evans Oil & Gas Co., Petroleum Exporation Co., Johnson Oil & Gas Co., Snowden & McSweeney Inc.

ILLINOIS

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Westfield	Clark	1904
(b) Martinsville	Clark	1907
(c) Main (several pools)	Crawford	
(d) Lawrence	Lawrence & Crawford	1906

II. Approximate Number of Limestone Fields Producing Oil or Gas Prior to 1932, 8.

III. Approximate Number of Companies Operating in State Prior to 1932, 10. Names of Companies: Tidewater Oil & Gas Co., Ohio Oil Co., W. C. McBride Inc., Kewanee Oil & Gas Co., Bell Bros., Mahutska Oil Co., Big Four Oil & Gas Co., Hamilton Oil & Gas Co., American Oil & Gas Dev. Co., Craig & Lowery.

NORTH LOUISIANA

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Bethany-Waskom	Caddo	1916
(b) Caddo	Caddo	1904
(c) Monroe	Union, Morehouse Ouachita	1916
(d) Rodessa	Caddo	1930
(e) Swalle	Sabine	1928
(f) Pine Island	Caddo	1906
(g) Sligo	Bossier	1922

II. Approximate number of limestone fields producing oil and gas prior to 1932, 12.

III. Approximate number of companies operating in state prior to 1932, 10. Names of Companies: Union Producing Co., United Carbon Co., Southern Carbon Co., The Hunter Co., Magnolia Petroleum Co., Ohio Oil Co., Texas Co., Standard Oil Co. of Louisiana, Stanolind Oil & Gas Co., Arkansas Fuel Oil Co.

WYOMING

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Black Mt.	Hot Springs	1925
(b) Byron	Big Horn	1932
(c) Garland	Big Horn-Park	1927
(d) Hamilton Dome	Hot Springs	1918
(e) Warm Springs	Hot Springs	1917
(f) Oregon Basin	Park	1926
(g) Lander	Fremont	1914

II. Approximate number of limestone fields producing oil or gas prior to 1932, 15.

III. Approximate number of companies operating in State prior to 1932, 18. Names of Companies: Ohio Oil Co., Continental Oil Co., Midwest Refg. Co., Texas Co., Sinclair-Wyoming Oil Co., Atlantic & Pacific Oil Co., Stock Oil Co., Argo Oil Co., Empire State Oil Co., Kinney Coastal Oil Co., Utah Refining Co.

MONTANA

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Kevin Sunburst	Toole	1922
(b) Pondera	Teton	1927

II. Number of Limestone fields producing oil or gas prior to 1932, 2.

III. Approximate number of Companies operating in State prior to 1932, 11. Names of Companies: California Co., Continental Oil Co., Texas Co., Texas Pacific Coal & Oil Co., Ohio Oil Co., W. E. Rice, Stanolind Oil & Gas Co., Triangle Oil & Gas Co., Boris A. S. Aranow, 56 Petroleum Co., Homestake Oil Co.

Plaintiff's Exhibit 192

NEW MEXICO

I. First Limestone Fields—

Field	County	Date of Discovery
(a) Artesia	Eddy	1923
(b) Eunice	Lea	1928
(c) Hobbs	Lea	1928
(d) Jal	Lea	1927
(e) Maljamar	Lea	1926

II. Approximate number of Limestone fields producing oil or gas prior to 1932, 9.

III. Approximate number of companies operating in State prior to 1932, 25. Names of Companies: Maljamar Oil Co., Repollo Oil Co., Stanolind Oil & Gas Co., Texas Co., Empire Oil & Refining Co., Continental Oil Co., Tidewater Oil Co., Humble Oil & Refining Co., Gulf Oil Co., Phillips Petroleum Co., Amerada Petroleum Co., Skelly Oil Co., Shell Oil Co., Ohio Oil Co., Atlantic Refining Co., Sun Oil Co.

HISTORY OF ACIDIZING

In Fields Discovered Prior to 1932

State	Company	Approximate Number of Treatments
Illinois		
	W. C. McBride	29
	Big Four Oil & Gas Co.	10
	Ohio Oil Co.	10
	Miscellaneous	50
Indiana		
	Big Four Oil & Gas Co.	4
	Siose Oil Co.	1
	Chas. Parriott	5
	See Oil Co.	5
	Miscellaneous	16

Plaintiff's Exhibit 192

State	Company	Approximate Number of Treatments	
		Eastern Kansas	Western Kansas
Kansas			
	Skelly	37	97
	Stanolind	7	308
	I. T. I. O.		25
	Continental Oil	7	5
	Phillips	16	121
	W. C. McBride		69
	Darby Petroleum Co.		23
	Twin Drilling Co.		4
	Cities Service Oil Co.	117	121
	Bay Petroleum Co.		3
	Lario Oil & Gas Co.	1	8
	Atlantic Refg. Co.		6
	Spencer-Yarnell	5	
	Texas Co.	2	157
	Derby Oil Co.	1	15
	Sinclair Prairie	79	520
	Gulf Oil Co.	2	61
	T. C. Johnson	2	29
	Shell Oil Co.		201
	Wilcox Petroleum Co.	10	31
	Carter Oil Co.		11
	Coralena Oil Co.		
	Central Petroleum Co.	7	67
	Bridgeport Machine		20
	Alva Billings		16
	Barbara Oil Co.	10	2
	Vickers Pet Co.	12	5
	Kanoko Oil & Gas Co.		8
	Olson Oil Co.		28
	Westgate Greenland		3
	Tom Palmer		12
	Pryor & Lockart	2	12
	Transwestern		12

Plaintiff's Exhibit 192

State	Company	Approximate Number of Treatments	
	J. E. Mabee		45
	Meade Prod. Co.		10
	Aikman & Braden	7	13
	British American		1
	O.K.O. Oil & Gas Co.		13
	Adair Morton	22	
	Red & Morris	2	
	W. O. James	11	
	Cox & McGinnis	6	
	Pure Oil Co.	21	
	Superior Oil Co.	4	
	Amerada Pet Co.	6	
	Jayhawk Oil Co.	19	
	Shull Drg. Co.	16	
	Woodson Pipe Line Co.	10	
	Sagamore Oil & Gas Co.	32	
	Alf. M. Landon	4	
	Barnsdall		27
	J. C. Shaffer		23
	Continental Oil Co.		30
	Bishop Oil Co.		2
	J. J. Hall		8
	Ohio Oil Co.		2
Kentucky			
	Texas Co.		10
	South Penn		11
	Petroleum Exploration		6
	Evans Oil & Gas		3
	Miscellaneous		93
Louisana			
	Union Prod. Co.		320
	Southern Carbon Co.		126
	Interstate Natural Gas		72
	United Carbon Co.		29

Plaintiff's Exhibit 192

State	Company	Approximate Number of Treatments
	D. Thompson Drg. Co.	17
	Hunter Co.	55
	Magnolia	11
	Crescent Drg. Co.	14
	Ohio Oil Co.	5
	Stanolind	58
	Texas Co.	35
	Magnolia	34
	Miscellaneous	543
Michigan		
	Pure Oil Co.	60
	Stanolind	5
	Wittmer Oil & Gas	27
	Chartiers Oil Co.	23
	Miscellaneous	648
New Mexico		
	Maljamar Oil Co.	23
	Barnsdall	4
	Sinclair	6
	Skelly	1
	Repello	33
	Stanolind	10
	Texas	27
	Empire Oil & Refg. Co.	8
	Continental	27
	Tidewater	10
	Humble Oil & Gas Co.	8
	Phillips	34
	Stanolind	39
	Amerada	26
	Gulf	2
	Shell Oil Co.	23
	Skelly Oil Co.	1
	Ohio Oil Co.	9
	Miscellaneous	32

Plaintiff's Exhibit 192

State	Company	Approximate Number of Treatments
Oklahoma		
	Pure Oil Co.	70
	Shell Oil Co.	28
	Skelly Oil Co.	26
	Gulf Oil Corp.	42
	Magnolia Oil Co.	11
	Sinclair Prairie	286
	Texas Co.	37
	Mid-Continent	26
	Atlantic Refining Co.	47
	Carter Oil Co.	199
	Tidewater Oil Co.	13
	Ohio Oil Co.	0
	Phillips Petroleum Co.	51
	Deep Rock Oil Co.	15
	Barnsdall Oil Co.	5
	Amerada Oil Co.	27
	Cities Service Oil Co.	81
	Continental Oil Co.	19
	Stanolind Oil & Gas	63
	I. T. I. O.	60
	Champlin Refining Co.	11
	Denver Producing & Refining	152
	Sun Oil Co.	2
	Darby Oil Co.	27
	Sunray	9
	British American	11
	Miscellaneous	1028
Ohio		
	Marxer & Lung	20
	Murry B. Chidester	25
	Ohio Oil Co.	10
	Wehrle Bros.	18
	J. L. Morrisey	6
	Wiser Oil Co.	3
	Miscellaneous	73

Plaintiff's Exhibit 192

State	Company	Approximate Number of Treatments
Texas (west)		
	Gulf Oil Corp.	82
	Humble Oil & Refining Co.	65
	Tidewater	9
	Cities Service Oil	1
	Sinclair-Prairie	39
	Texas Co.	35
	Phillips Petroleum Co.	2
	American Liberty Oil	11
	Barnsdall Oil Co.	3
	Standard Oil Co. of Texas	48
	Skelly Oil Co.	20
	Laudreth Petroleum Co.	40
	Stanolind Oil & Gas Co.	50
	Continental	65
	Atlantic Refining Co.	47
	Shell Oil Co.	93
	Sun Oil Co.	6
	Amerada Petroleum Co.	21
	Pure Oil Co.	16
	Mid-Kansas (Ohio Oil Co.)	13
	Texas, Pacific Coal & Oil Co.	10
	Big Lake Oil Co.	41
	Miscellaneous	226
Texas (North Central)		
	Lone Star	10
	Sinclair Prairie	18
	Shell	3
	Continental	38
	Miscellaneous	35
Texas (Panhandle)		
	Barnsdall	6
	British American	1
	Cities Service	22
	Gulf Oil Corp.	13

Plaintiff's Exhibit 192

State	Company	Approximate Number of Treatments
	Humble Oil & Refining Co.	4
	I. T. I. O.	5
	Magnolia	21
	Ohio Oil Co.	2
	Panhandle Eastern	20
	Phillips	99
	Pure Oil Co.	1
	Continental	30
	Texas Co.	12
	Shell	27
	Sinclair-Prairie	16
	Shamrock Oil Co.	43
	Skelly Oil Co.	20
	Sun Oil Co.	2
	Stanolind	25
	Miscellaneous	48
South Texas		
	Sun Oil Co.	1
	McAlester Fuel Co.	4
	Rio Bravo Oil Co.	2
	R. E. Fair	2
	Magnolia Petroleum Co.	62
	Forest Development Co.	7
	Felmont Corp.	5
	Trio Oil Co.	16
	Miscellaneous	55
Montana		
	Aranon	16
	W. E. Rice	61
	Lon Crumley	18
	New Era Fuel Co.	10
	Wm. Fulton	10
	D. S. Kelley	8
	Stanolind	39
	Texas	19
	Miscellaneous	168

State	Company	Approximate Number of Treatments
Wyoming		
	Ohio Oil Co.	12
	Yale Petroleum Co.	12
	Stock Oil Co.	20
	Argo Oil Co.	6
	Miscellaneous	30

PLAINTIFF'S EXHIBIT 195

(Montana Oil and Mining Journal, Jan. 26, 1935)

PONDERA PRODUCTION UP 22,000 BARRELS

Use of Acid Boosts Field Production Total 3,675,391 Bbls.

With no new drilling, Pondera oil field increased its production during 1934 by 22,210 barrels over 1933, according to official production figures compiled in the office of the Petroleum Conservation Board.

This increase in production was due to the use of acid on the lime formation in these wells, chiefly during the latter part of the year.

The 1934 production brings the total yield of the field up to 3,673,391.74, which has been marketed for slightly more than three millions of dollars.

The 1933 production, totaling 338,189 barrels, sold for $227,749.80.

The 1934 production, totaling 360,399.91 barrels, sold for $450,499.89.

The tremendous gain for the producers is due to the fact that during the entire year of 1934 the oil sold for $1.25 per barrel, whereas in 1933 oil sold for 60 cents per barrel up to June 17 and thereafter for 75 cents during the balance of the year.

The average production per well in Pondera field is in excess of $20,000. The average per acre yield of the field to date is approximately $4,000.

The drilling of not less than 12 and perhaps as many as 20 wells is expected in this field during the coming year, chiefly to the north and northwest of present production. The other limits of the field are defined.

Following is the total production by years and the production by months for the year 1934:

1928	175,000.00
1929	1,007,782.70
1930	757,207.49
1931	559,266.22
1932	477,546.12
1933	338,189.30
1934	360,399.91
Total	3,675,391.74

	1934
January	28,849.13
February	24,033.51
March	27,852.53
April	26,484.03
May	26,799.07
June	25,603.85
July	26,646.09
August	27,313.12
September	29,324.03
October	38,647.13
November	39,257.50
December	39,589.92
Total	360,399.91

PLAINTIFF'S EXHIBIT 218-A

Old Dixie Pump P. D.

Mumy #2; 6-22-1932; 6 carboys used; Put in with Bailer; 80 bls. oil used; 200 lbs. P.

Mumy #3; 6-29-1932; 18 carboys used; dumped in; 85 bls. oil used; 300 lbs. Pressure.

PLAINTIFF'S EXHIBIT 218-B

Old Dixie pump 200 bb. 24 hrs.

Acid used Hastings #1; 7-24-1932; 1,000 gal.; Casing Head 500 lbs.; tubing 250 to 300; Wells F. Malcom.

Struble #1; 1,000 gal.; Casing Head No Pressure; tubing Vacuum; 7-26-1932; McAllahan Oil Co.; 367 bb. 24 hrs.

Coon #1; 1000 Gal.; Casing Head 100 to 300; tubing 30 to 100; Stork Oil Co.; 7-27-1932; 80 bls. 10 hrs.

Root #1; 1000 gal.; Tube Pressure None; casing; Packer 2"; 7-30-1932.

8-1-1932; Cole # 1; J. C. Arthurs; 1000 gal. Dixie Pump; No oil used; No Pressure; Poor connections.

8-2-1932; Morrison #2; W. L. McAllahan; 1000 gal. Dixie Pump; Very little pressure; 80 bls. oil used.

8-6-1932; Hastings #1 Dixie P.; Second time—1000 gal.; Pressure tub. 50; Oil used—none.

8-5-1932; Stork Oil Co.; Coon #4; 1000 gal.; Pressure none; Oil used 60 bls.; Dixie pump.

8-7-1932; G-Lee-P Oil Co. 1000; Schaffer #1; Pressure —; Oil used 7"; Dixie pump.

PLAINTIFF'S EXHIBIT 218-C

8-8-1932; Columbia Oil Gas Co.; Rornick #3; 500 Gal.; No Pressure; Simarall Pump.

8-9-1932; McAllahan; Schaffer #1; 1000 gal.; 450 Pressure tubing; 900 Pressure casing head; Simarall Pump.

8-11-1932
Two Well 500 each
Witt-Nelson
Muskegon
No pressure
Dixie Pump

2 well

8-15-1932; Michigan Oil Gas Co.; 1000 gal.; Mudding machine pump.

8-16-1932; Columbia Oil Gas; 2 well 500 gal. Each; Simarall Pump; Arthur's Truck.

Parafine Walting chemical; Carbon Bisulphide (Dow).

8-18-1932; Columbia Oil Gas; 1000 gal.; 300 Pressure; Mudding machine.

8-24-1932; Talbot Oil Co.; Adams #1; 500 gal.; No Pressure.

8-24-1932; Jones Oil Co. Voorhies; Jones #1; 500 gal.

8-26-1932; Shuller, Voorhies, Wilson, Strange; Well #1; Reimenschneider; 1300 gal.; 150 to 300 pressure.

8-28-1932; Struble #2; McCallahan; 1000 gal.; 800 lbs. Pressure; 75 bls. oil.

PLAINTIFF'S EXHIBIT 218-D

8-28-1932; Gordon Oil Gas Co.; Columbia Oil Gas Co.; Tanker #1; 1000 gal.

9-1-1932; Schaffer #1; McAllahan; 1000 gal.; 300 P. Casing Head—tub. 50 lbs.; 123 bls. Oil Used.

9-6-1932; Stork Oil Co.; No. P. Pump no good; 500 gal.

9-11-1932; G-Lee-P Schaffer #1; 500 gal.; No. P.

9-12-1932; Talbot; 500 gal.;

9-12-1932; Columbia-Gordon; 1000 Gal.

PLAINTIFF'S EXHIBIT 231-A

THE DOW CHEMICAL COMPANY
Midland, Michigan

Dept. Chlorbenzol Date 2-9-32 Order No. 38118
Ship to: Pure Oil Co.,
Mt. Pleasant Oil Field
Route: To be called for by Pure Oil Co. Truck 2/11
Date shipped: Feb. 11, 1932

	Price
1 Wagon Load Hydrochloric acid (Strong)	NC

PLAINTIFF'S EXHIBIT 231-B

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 3537
Dept. Hydrochloric Acid (Don Hall) Date 3-9-32 Order No.
Invoice to: Same 40327
35 E. Wacker Drive
Chicago, Ill.
Date to be shipped: Will call for 3-10-32
Ship to Pure Oil Co.,
Oil Field
Route: Pure Oil will call for
Date Shipped: Mar. 11, 1932.
Special Instructions to Traffic and Shipping Clerk
Pure Oil will call for 3/10-32

	Price	Amount
500 Gallons Approx 10° Be Hydrochloric Acid 4500# =$14.00 per ton Basis 18° Acid 2500 @ 14.00		
	as 18° per ton	$17.50
To be loaded in tank wagon		
Plus handling charges........................		4.68
See R. L. C.		22.18

PLAINTIFF'S EXHIBIT 231-C

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 4516

Dept. Don Hall   Date 4-4-32   Order No. 42252
Invoice to: Same
35 E. Wacker Drive
Chicago, Ill.
Date to be shipped: Do not ship
Ship to: Pure Oil Co.,
Oil Field
Date Shipped Apr. 5, 1932
Route Called for Customers Truck

	Price	Amount
500 Gals. Approx. 10° Be Hydrochloric Acid 2500	\$14.00 per ton Basis 18 acid	\$17.50
Plus 2 portions arsenic acid — Total	6.38........	6.38
Labor Tank Service—Transfer chg. "	5.80........	5.80
		29.68

PLAINTIFF'S EXHIBIT 231-D

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 5977

Dept. Benzol Date 4-26-32 Order No. 44094
Invoice to: Same
Date to be shipped Will call 4/27

Customer's Order No. 4/20/32
Date Shipped May 3, 1932

Ship to Pure Oil Producing Co.,
Mt. Pleasant, Mich.
Route: Will call with their truck
Special instructions to traffic and shipping clerk
Truck to stop at 65 bldg. to have arsenic acid placed in tank

	Price	Amount
1 tank load 500 gal. Dow hydrochloric acid (approx 10 Be)	14.00 Ton Basis 18 acid	$17.50
Plus 1 portion arsenic acid Total...............		3.19
Labor—tank service—transfer chg. total........		4.00
		$24.69

PLAINTIFF'S EXHIBIT 231-E

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 6121

Dept. Don Hall Date 5-5-32 Order No. 44793
Invoice to: Same
Date to be shipped: Will Call 5-5-32

Date Shipped May 5, 1932

Ship to: The Pure Oil Producing Co.,
Mt. Pleasant, Mich.
Route: Will call with their truck

	Price	Amount
1 tank load (500 gal.) Dow hydrochloric acid	14.00 per ton	$17.50
(Approx 10 degrees Be)	3.19 Total	3.19
1 portion arsenic acid		
Labor—Tank Service—Transfer Chg.	4.00 Total	4.00
		$24.69

PLAINTIFF'S EXHIBIT 231-F

THE DOW CHEMICAL COMPANY
Midland, Michigan

Folio 7105

Dept. Don Hall   Date 5-20-32   Order No. 46068
Invoice to: Same
Date to be Shipped Will call 5/20
Ship to: Pure Oil Producing Co.,
Mt. Pleasant, Mich.
Date Shipped May 21, 1932
Route: Will call with their truck

	Price		Amount
Tank load (500 gal.) Dow hydrochloric acid	$14.00		$17.50
(Approx 10 Be)			
1 portion arsenic acid	3.19	Total	3.19
Labor—tank service—transfer chg.	4.00	Total	4.00
			$24.69

PLAINTIFF'S EXHIBIT 231-G

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 7323

Dept. Don Hall Date 5-24-32 Order No. 46377
Invoice To: Same
Date to be shipped: Will call 5/25
Ship to: Pure Oil Producing Co.,
Mt. Pleasant, Mich.
Date Shipped: May 25, 1932
Route: Will call with truck

	Price		Amount
Tank load (500 Gal.) Dow hydrochloric acid	14.00		$17.50
(Approx 10 Be)			
1 Portion Arsenic Acid	3.19	Total	3.19
Labor—Tank service—transfer chg.	4.00	Total	4.00
			$24.69

PLAINTIFF'S EXHIBIT 231-H

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 7481

Dept. Don Hall Date 5-26-32 Order No. 46,567
Invoice to: Same
Date to be shipped: May 27
Ship to Pure Oil Producing Co., Customer's Order No.
Mt. Pleasant, Mich. Phone 5/26/32 R. F. S.
Date Shipped: May 27, 1932.
Route: Will call with truck

	Price		Amount
Tank load (500 gal.) Dow hydrochloric acid	$14.00		$17.50
Approx 10 Be			
1 portion arsenic acid	3.19	Total	3.19
Labor,—tank service,—transfer chg.	4.00	Total	4.00
			$24.69

PLAINTIFF'S EXHIBIT 231-I

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Folio 7542

Dept. Don Hall **Date 5-26-32** **Order No. 46568**
Invoice to: Same
Date to be shipped May 28
Customer's Order No. Phone 5/26/32
**Ship to: Pure Oil Producing Co.,
Mt. Pleasant, Michigan.**
Route: Will call with truck
Date shipped: May 28, 1932

	Price		Amount
Tank carload (500 Gal.) Dow hydrochloric acid—Approx. 10 Be	$14.00		$17.50
1 portion arsenic acid	3.19	Total	3.19
Labor—Tank service—transfer chrgs.	4.00	Total	4.00
			$24.69

PLAINTIFF'S EXHIBIT 231-J

THE DOW CHEMICAL COMPANY
Midland, Michigan, U. S. A.

Dept.: Don Hall   Date 5-31-32   Folio 7625
Invoice to: Same   **Order No. 46763**
Date to be shipped **May 31**
Ship to: Pure Oil Producing Co.,
Mt. Pleasant, Mich.
Date **Shipped May 31, 1932.**
Route: **Will call with truck**

	Price		Amount
Tank load (500 Gal.) Dow Hydrochloric Acid	14.00		$17.50
(Approx 10 Be)			
1 portion arsenic acid	3.19	Total	3.19
Labor—Tank service—Transfer chg.	4.00	Total	4.00
			$24.69

PLAINTIFF'S EXHIBIT 232

DOWELL INCORPORATED
Well Treatments

	1932	1933	1934	1935	1936	1937	1938	1939	1940	Total
Total Treatments	59	1,121	1,988	2,144	3,057	4,764	3,850	4,241	5,522	26,746
Deductions:										
California Treatments	0	0	0	0	2	32	91	48	42	215
Houston District—										
Mud Acid Treatments	0	0	0	0	0	0	3	93	241	337
Dow Chemical Treatments	0	2	0	0	3	5	7	3	21	41
Truck Rentals	0	0	0	1	25	34	51	88	148	347
Stuck Drill Pipe	0	0	4	20	31	23	6	21	28	133
Packer Treatments	0	0	0	0	2	4	18	8	1	33
Total Deductions	0	2	4	21	63	98	176	261	481	1,106
Net Total	59	1,119	1,984	2,123	2,994	4,666	3,674	3,980	5,041	25,640

PLAINTIFF'S EXHIBIT 233

TREATMENTS MADE BY LICENSEES OTHER THAN DOWELL

This report does not include treatments made by California licensees.

	1934	1935	1936	1937	1938	1939	1940
January	0	0	15	27	43	37	29
February	0	14	15	23	26	38	23
March	0	0	17	35	25	50	33
April	0	2	19	52	39	66	59
May	0	11	15	31	32	64	53
June	0	1	32	44	27	57	47
July	0	13	23	39	39	58	34
August	3	17	23	36	39	53	50
September	8	3	21	40	27	49	36
October	13	0	23	42	37	55	31
November	14	1	17	27	45	58	27
December	0	14	36	24	27	50	24
	38	76	256	420	406	635	446

Total—2,277

Shipment Record

Product Hydrochloric Acid

Month of Jan., 1932

No.	Date	Order No.	Consignee	No.	Size	Grade	Net Wt.
1	1-23	28590	Ford Motor Co., Detroit, Mich.	Dow X	R8332	18° B.	
			Gross wt. 103,500				
			44,100				
			59,400				
			27.9%				16,550

Month of Feb., 1932

No.	Date	Order No.	Consignee	No.	Size	Grade	Net Wt.
1	2- 2	34614	Cincinnati Chem. Works, St. Bernard, Ohio.	GATX	1765	61750 Gross	20,450
2	2-11	38118	Pure Oil Co., Mt. Pleasant Oil Field	1	Wagon	15% HCl	790
3	2-17	38660	Kleen-Kwik Chem. Co., Flint, Mich.	15 bbls.		19.7 B 30.9%	2,416
4	2-19	36530	Cincinnati Chem. Wks., Norwood, Ohio	Dow X	R8332	31.8%	24,104
5	2-22	38779	Kleen-Kwik Chem. Co., Flint, Mich.	15 bbls.		32.38%	2,596
6	2-24	39143	" " "	15 bbls.		31.5%	2,463
7	2-26	39057	Cincinnati Chem. Works, Norwood, Ohio.	GATX	1765	20B 32.03%	23,734
			2 Gal. Arsenic Pure Oil (notation below)				76,553

Month of March, 1932

No.	Date	Order No.	Consignee	No.	Size	Grade	Net Wt.
1	3- 4	39259	Kleen-Kwik Chem. Co., Flint, Mich.	15	Bbls.	7750# 31.5	2,441
2	3-11	40327	Pure Oil Co., Oil Field	5000# of		15%	750
3	3-16	40560	The Sherwin Williams Co., Kensington, Ill.	GATX	1767	18° B.	19,250
4	3-16	40062	Kleen Kwik Chem. Co., Flint, Mich.	15 Bbls.		7880 32%	2,521
5	3-19	41039	General Dry Batteries, Cleveland, Ohio.	GATX	1765	18°	16,800
6	3-31	40774	Cincinnati Chem. Works, Norwood, Ohio	GATX	1768	20° B.	24,500
			March HCl sales				66,262

	1767	1768
HCl ad.	68800	76100
%	27.98	32.2

2 gal. Arsenic Pure Oil (notation below)

Month of April, 1932

No.	Date	Order No.	Consignee	No.	Size	Grade	Net Wt.
1	4- 2	41832	Ford Motor Co., Detroit, Mich.	Dow X	R8332	18° B. 68 cu. ft.	17,615
2	4- 5	42252	Pure Oil Co., Oil Field	1 Tank W		15% HCl	750

			St. Bernard, Ohio				
4	4-27	44094	Pure Oil Co.,			68 cu. ft.	
			Mt. Pleasant, Mich.	1 Tank W		15%	750
5	4-29	44298	Peebles Chem. Co., Wash., D. C.	1 Bottle		20° B.	
			Dow X R8332 61,700 18				
			GATX 1765 74,500 20				43,101
			4 gal. Arsenic Acid Pure Oil (notation below)				
			St. Bernard, Ohio	GATX	1765		23,400

Month of May, 1932

No.	Date	Order No.	Consignee	No.	Size	Grade	Net Wt.
1	5- 4	44568	Sherwin & Williams, Kensing-				
			ton, Ill.	Dow X	R8332	18° B.	14,850
2	5- 5	44793	Pure Oil Co., Mt. Pleasant, Mich.	Trailer tank		15%	750#
3	5- 6	42937	Cincinnati Chem. Wks.,				
			Norwood, Ohio	GATX	1768	20° B.	24,100
4	5-10	45227	General Dry Batteries,				
			Cleveland, Ohio	GATX	1767	18° B.	17,520
5	5-16	45057	Ford Motor Co., Detroit, Mich.	GATX	1766	18° B.	16,700
6	5-21	46068	Pure Oil Co., Mt. Pleasant, Mich.	Trailer Tank		15%	750
7	5-25	46377	Pure Oil Co., Mt. Pleasant, Mich.	Trailer Tank		15%	750
8	5-27	46567	" " "	Trailer Tank		15%	750
9	5-28	46568	Pure Oil Producing Co.,				
			Mt. Pleasant, Mich.	Trailer Tank		15%	750
10	5-31	46763	Pure Oil Producing Co.,				
			Mt. Pleasant, Mich.	Trailer Tank		15%	750
			8332 53400	27.92			
			1768 73600	32.75			
			1767 62400	28.09			
			1766 56500	29.48			
			12 gal. Arsenic Pure Oil (notation below)				77,670

Month of June, 1932

No.	Date	Order No.	Consignee	No.	Size	Grade	Net Wt.
1	6- 1	46,904	Columbia Oil & Gas Co.,				
			Mt. Pleasant, Mich.	6	cby.	15%	80
2	6- 3	47,081	Pure Oil Producing Co.,				
			Mt. Pleasant, Mich.	1	tank	15%	750
3	6- 4	47,141	Columbia Oil & Gas Co.,				
			Mt. Pleasant, Mich.	4	cbys.	15%	53
4	6- 4	46,936	Lawrence Lee, Midland, Mich.	1	tank	15%	750
5	6- 7	47,527	Cincinnati Chem. Co.,				
6	6- 7	47,522	Columbia Oil & Gas Co.,				
			Shepherd, Mich.	6	cbys.	15%	80
7	6- 9	47,629	Lawrence Lee, Midland, Mich.	1	tank	15%	750
8	6-11	47,869	Pure Oil Co., Mt. Pleasant, Mich.	1	tank	15%	750
9	6-13	47,850	Ford Motor Co., Detroit, Mich.	GATX	1766	18° B.	16,700
10	6-13	48,065	Pure Oil	1	W.	15%	750
11	6-15	48,270	Pure Oil Co., Mt. Pleasant, Mich.	1	W.	15%	750
12	6-16	48,106	Chippewa Oil & Gas Co.,				
			Midland, Mich.	1	500 gal.	15%	750
13	6-17	48,343	Mt. Pleasant Oil & Gas Co.,				
			Mt. Pleasant, Mich.	1	500 gal.	15%	750
14	6-17	48,519	Pure Oil Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
15	6-16	48,343	W. L. McClanahan,				
			Mt. Pleasant, Mich.	1	500 gal.	15%	750
16	6-18	48,537	Lawrence Lee, Midland, Mich.	1	500 gal.	15%	750
17	6-18	48,563	Talbot Oil Co., Midland, Mich.	1	500 gal.	15%	750
18	6-20	48,681	Pure Oil Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
19	6-20	48,634	Lawrence Lee, Midland, Mich.	1	500 gal.	15%	750
20	6-20	48,700	The Gorden Oil Co.,				
			Mt. Pleasant, Mich.	1	500 gal.	15%	750

11	6-15	48,270	Pure Oil Co., Mt. Pleasant, Mich.	1	W.	15%	750
12	6-16	48,106	Chippewa Oil & Gas Co., Midland, Mich.	1	500 gal.	15%	750
13	6-17	48,343	Mt. Pleasant Oil & Gas Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
14	6-17	48,519	Pure Oil Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
15	6-16	48,343	W. L. McClanahan, Mt. Pleasant, Mich.	1	500 gal.	15%	750
16	6-18	48,537	Lawrence Lee, Midland, Mich.	1	500 gal.	15%	750
17	6-18	48,563	Talbot Oil Co., Midland, Mich.	1	500 gal.	15%	750
18	6-20	48,681	Pure Oil Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
19	6-20	48,634	Lawrence Lee, Midland, Mich.	1	500 gal.	15%	750
20	6-20	48,700	The Gorden Oil Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
21	6-21	48,751	Pure Oil Co., Mt. Pleasant, Mich.	1	1000 gal.	15%	1,500
22	6-22	48,853	Stork Oil Co., Isabella County	1	500 gal.	15%	750
23	6-22	48,879	Pure Oil Co., Mt. Pleasant, Mich.	1	1000 gal.	15%	1,500
24	6-23	49,001	Pure Oil Co., Mt. Pleasant, Mich.	1	1000 gal.	15%	1,500
25	6-24	49,002	Pure Oil Co., Mt. Pleasant, Mich.	1	1000 gal.	15%	1,500
26	6-25	49,003	Pure Oil Co., Mt. Pleasant, Mich.	1	1000 gal.	15%	1,500
27	6-25	49,236	Michigan Gas & Oil Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
28	6-27	49,232	Pure Oil Co., Mt. Pleasant, Mich.	1	1000 gal.	15%	1,500
29	6-28	49,380	Lupher Drilling Co., Mt. Pleasant, Mich.	2	cbys.	15%	25
30	6-28	49,455	Ohio Producing & Refining Co., Mt. Pleasant, Mich.	1	500 gal.	15%	750
31	6-28	49,664	Pure Oil Co., Mt. Pleasant	1	1000 gal.	15%	1,500
32	6-29	49,422	Lawrence Lee, Midland, Mich.	1	1000 gal.	15%	1,500
33	6-30	49,666	Pure Oil Co., Mt. Pleasant	1	1000 gal.	15%	1,500
34	6-30	49,550	General Dry Batteries, Cleveland, Ohio.	GATX	1765	18°	16,500
35	6-30	48,981	Lawrence Lee, Midland, Mich. (Ohio)	1	500 gal.	15%	750
			44 gal. Arsenic Pure Oil (notation below)				
			28 gal. Arsenic Misc. (notation below)				

PLAINTIFF'S EXHIBIT 305

First Treatment of Pure Oil Co. Well with Inhibited Acid, as reported by Robert Quinlan

The well treated was known as the Fox, either No. 5 or No. 6. I believe it was No. 5, but am not positive. This can be ascertained from State Conservation Department agents at Mt. Pleasant.

At the time I was employed in the Physics Laboratory of The Dow Chemical Company, under supervision of Mr. J. J. Grebe. On February 10, 1932 (the day before the well was treated) Mr. R. T. Sanford called me on the telephone and asked me to come to his office. I went to Mr. Sanford's office, where he told me that arrangements had been made to treat one of Pure Oil Company's wells with acid, and instructed me to get ready a tank wagon load of hydrochloric acid which was to be diluted to about 15% strength and was to have arsenic acid added to it as inhibitor, the amount of the latter to be 2 gallons of arsenic acid to 500 gallons of acid.

On the next morning (February 11, 1932) I obtained one of The Dow Chemical Company's tank wagons, on which was a 36 inches diameter by 12 feet long horizontal wood tank. This tank wagon was hauled by a truck. First I went with the tank wagon to the Lead Arsenate Plant of The Dow Chemical Company, where I got 2 gallons of arsenic acid and poured it into the tank. Then I went with the tank wagon to the Chlorbenzol Plant, where 19 inches of water was first run into the tank and then 17 inches of strong (about 33% HCl) hydrochloric acid. This gave a diluted solution in the tank which tested 10° Beaumé by hydrometer.

Before leaving the Dow plant I got a pair of rubber gloves from Mr. Sanford's car, which he had told me were there. I rode on the truck which hauled the tánk wagon of acid out to the well. After we arrived there Mr. San-

ford also came in his own car. A representative of the Pure Oil Company was at the well, whom I afterward found to be a Mr. Albert Lenz or Linz, then local field superintendent for the Pure Oil Company. He had two laborers there, also. The rods and valves had been pulled when we arrived. Upon arrival at the well I measured the depth of acid in the tank, using a new rule which Mr. Sanford supplied. Then I helped prepare and prime a siphon for feeding the acid into the well pipe. A 1-¼ inch rubber hose, about 40 feet long, was used. I placed one end of the hose in the acid tank and held up the other end while one of the laborers filled the hose with oil which he drew into a pail from an oil tank at hand. When the hose was filled with oil I pushed it down into the well pipe far enough to take up all of the slack lying on the ground. The acid ran into the well through the rubber hose, being continued until the depth of acid in the tank had dropped 10 inches. This amounted to about 125 gallons. The hose was then lifted out of the well pipe and tied up so as not to lose the prime of the siphon. The acid tank wagon was left at the well, and Mr. Sanford left instructions to make additional treatments of 125 gallons of acid at successive intervals. I rode back to Midland with Mr. Sanford, and did not return to make any further treatments of this well. However, I was the only man present having rubber gloves when the first treatment with acid was made, and I measured the acid tank, helped start the siphon, placed the hose in the well pipe and held it while the acid ran in during this first treatment.

Robert J. Quinlan.

Sworn to and subscribed before me this 5th day of December, 1932.

Geneva Turner,
Notary Public.

My commission expires July 7, 1934.

PLAINTIFF'S EXHIBIT 328

TABLE 1

Treat. No.	Company Name	Well Name	Date Treated	Acid Gals. Used	Gauge—C. F. Before Acid	Gauge—C. F. After Acid	Per-cent In-crease	Cu. Ft. Per Gal. of Acid
491	Stanolind Oil & Gas Co.	Cal Merchant #2	9/22/37	3,000	3,000,000	6,800,000	127	1267
409	Cities Service Oil Co.	Hoerner #1	8/17/37	3,000	3,000,000	7,800,000	160	1600
528	Cities Service Oil Co.	Deahl #6	1/12/38	8,000	2,480,000	10,300,000	315	977
404	Canadian River Gas Co.	Bivin A #2	9/13/37	4,000	7,000,000	9,000,000	29	500
440	Shell Petroleum Co.	Russell #1	9/17/37	5,000	6,885,000	13,168,000	91	1257
455	Shamrock Oil & Gas Co.	Sneed #8	10/5/37	10,000	6,800,000	31,800,000	368	2500
463	P.E.P.L. Co.	Mesterson #1	10/21/37	10,000	5,400,000	34,400,000	537	2900
483	Phillips Petroleum Co.	Jones #3	12/14/37	5,000	7,000,000	25,242,000	261	3648
486	Texoma Natural Gas Co.	Deahl #2	12/27/37	5,000	6,300,000	12,000,000	90	1140
487	Texoma Natural Gas Co.	Texas Fee #3	12/29/37	5,000	6,000,000	11,500,000	92	1100
488	Shell Petroleum Co.	Longaneker #1	1/1/38	8,000	3,800,000	16,500,000	334	1587
489	Phillips Petroleum Co.	Clark Gable #2	1/1/38	5,000	6,800,000	27,562,000	305	4152
511	Phillips Petroleum Co.	Jones A #1	5/9/38	5,000	4,690,000	38,698,000	725	6802
526	Phillips Petroleum Co.	Jones #696-1	5/23/38	5,000	6,650,000	33,300,000	401	5330
401	Shamrock Oil & Gas Co.	J. T. Sneed #6	7/30/37	4,000	12,000,000	81,000,000	575	17250
415	Phillips Petroleum Co.	Ada #1	8/19/37	10,000	11,600,000	33,130,000	186	2153
420	Shell Petroleum Co.	Lucas #1	8/26/37	5,000	13,000,000	24,835,000	91	2367
429	Shell Petroleum Co.	Phillips #1	9/10/37	5,000	7,300,000	21,436,000	193	2827
434	Shamrock Oil & Gas Co.	McDowell #1	9/13/37	10,000	12,000,000	44,000,000	267	3200
444	Shell Petroleum Co.	Kraker #1	9/26/37	5,500	8,314,000	17,335,000	109	1644
446	Phillips Petroleum Co.	Preston #1	9/26/37	5,000	11,600,000	17,261,000	49	1132
456	Phillips Petroleum Co.	Loeber #1	10/6/37	10,000	9,900,000	29,974,000	203	2007
465	Shamrock Oil & Gas Co.	Sneed #9	11/4/37	10,000	9,000,000	59,000,000	556	5000
470	Phillips Petroleum Co.	Stanhope #1	11/13/37	10,000	14,000,000	37,213,000	166	2321
476	Shell Petroleum Co.	Wilbar #1	11/25/37	5,000	9,000,000	14,421,000	60	1084
527	Phillips Petroleum Co.	Fields #1	5/24/38	5,000	7,280,000	16,147,000	122	1773
368	Phillips Petroleum Co.	Pythian #1	5/10/37	5,000	25,000,000	45,101,000	80	4020
375	Phillips Petroleum Co.	Mary Beth #1	6/4/37	5,000	25,900,000	49,350,000	91	4690
386	Phillips Petroleum Co.	Sturdy #1	6/23/37	10,000	27,700,000	61,619,000	122	3392
390	Shamrock Oil & Gas Co.	Stewart #1	7/10/37	10,000	19,000,000	63,000,000	232	4400
393	Phillips Petroleum Co.	Marsh #1	7/17/37	10,000	16,000,000	56,000,000	250	4000
396	Phillips Petroleum Co.	Emily Nell #1	7/24/37	10,000	17,000,000	51,411,000	202	3441
398	Shell Petroleum Co.	A. Miller #1	7/26/37	5,000	23,200,000	30,930,000	33	1546
400	Shamrock Oil & Gas Co.	C. Jones #1	7/27/37	15,000	17,000,000	28,200,000	66	747
410	Shell Petroleum Co.	E. Miller #1A	8/18/37	5,000	21,910,000	36,007,000	64	2819
452	Shamrock Oil & Gas Co.	Sneed #1	10/1/37	10,000	28,537,000	41,305,000	45	1277
461	Phillips Petroleum Co.	Ochsner #1	10/20/37	5,000	24,250,000	49,834,000	105	5117
471	Shamrock Oil & Gas Co.	Shary #1	11/17/37	3,000	18,800,000	52,800,000	181	11333
477	Phillips Petroleum Co.	Ansley #1	11/28/37	10,000	16,000,000	47,021,000	194	3102
399	Shamrock Oil & Gas Co.	A. Sheed #2	8/9/37	10,000	31,600,000	78,900,000	150	4730
408	Shell Petroleum Co.	Hohlman #1	8/15/37	5,000	35,000,000	61,795,000	77	5359
413	Phillips Petroleum Co.	Stigall #1	7/24/37	5,000	31,700,000	80,179,000	153	9696
424	Phillips Petroleum Co.	Coffee #1	8/30/37	5,000	37,000,000	74,518,000	101	7504
426	Phillips Petroleum Co.	Venable #1	9/2/37	5,000	33,000,000	60,413,000	83	5483
430	Phillips Petroleum Co.	Texas #1	9/12/37	5,000	42,160,000	60,197,000	43	3619
448	Phillips Petroleum Co.	Ray #1	9/29/37	5,000	40,000,000	67,466,000	69	5493
490	Shamrock Oil & Gas Co.	Sneed #10	1/4/38	6,000	80,000,000	136,000,000	70	9333

TABLE 2

Pretreatment Open Flow	No. Wells in Group	Actual Average Open Flow	Acid Data: No. Stages	Acid Data: No. Gallons	After Treatment Data: Open Flow	After Treatment Data: Percent Increase	Cost Per One Million Ft. Gas: Original Open Flow A	Cost Per One Million Ft. Gas: Increase Due to Acid B	Percent B of A

398	Shell Petroleum Co.	A. Miller #1	7/26/37	5,000	23,200,000	30,930,000	33	1546
400	Shamrock Oil & Gas Co.	C. Jones #1	7/27/37	15,000	17,000,000	28,200,000	66	747
410	Shell Petroleum Co.	E. Miller #1A	8/18/37	5,000	21,910,000	36,007,000	64	2819
452	Shamrock Oil & Gas Co.	Sneed #1	10/ 1/37	10,000	28,537,000	41,305,000	45	1277
461	Phillips Petroleum Co.	Ochsner #1	10/20/37	5,000	24,250,000	49,834,000	105	5117
471	Shamrock Oil & Gas Co.	Shary #1	11/17/37	3,000	18,800,000	52,800,000	181	11333
477	Phillips Petroleum Co.	Ansley #1	11/28/37	10,000	16,000,000	47,021,000	194	3102
399	Shamrock Oil & Gas Co.	A. Sheed #2	8/ 9/37	10,000	31,600,000	78,900,000	150	4730
408	Shell Petroleum Co.	Hohlman #1	8/15/37	5,000	35,000,000	61,795,000	77	5359
413	Phillips Petroleum Co.	Stigall #1	7/24/37	5,000	31,700,000	80,179,000	153	9696
424	Phillips Petroleum Co.	Coffee #1	8/30/37	5,000	37,000,000	74,518,000	101	7504
426	Phillips Petroleum Co.	Venable #1	9/ 2/37	5,000	33,000,000	60,413,000	83	5483
430	Phillips Petroleum Co.	Texas #1	9/12/37	5,000	42,100,000	60,197,000	43	3619
448	Phillips Petroleum Co.	Ray #1	9/29/37	5,000	40,000,000	67,466,000	69	5493
490	Shamrock Oil & Gas Co.	Sneed #10	1/ 4/38	6,000	80,000,000	136,000,000	70	9333

TABLE 2

Pretreatment Open Flow	No. Wells in Group	Actual Average Open Flow	Acid Data No. Stages	Acid Data No. Gallons	After Treatment Data Open Flow	After Treatment Data Percent Increase	Cost Per One Million Ft. Gas Original Open Flow A	Cost Per One Million Ft. Gas Increase Due to Acid B	Percent B of A
0-3 million	3	2,826,666	1.7	4,666	8,300,000	194	$7,067	$238	3.3
3-7 million	11	6,120,454	2.3	6,090	23,015,454	276	3,268	98	3.0
7-15 million	12	10,416,166	2.4	7,042	32,979,333	217	1,923	83	4.3
15-30 million	13	21,561,307	2.6	7,923	47,121,384	119	925	81	8.7
Over 30 million	8	41,300,000	2.1	5,750	77,433,500	87	484	43	8.8
Average or Total	47	17,267,872	2.3	6,691	40,550,383	135	$1,156	$ 77	6.6%

PLAINTIFF'S EXHIBIT 329

RESULTS OF ACIDIZING GAS WELLS IN TEXAS PANHANDLE

Treatment No.	Customer	Well Name	County	Location Sec.	Location Blk.	Location Sur.	Date Treated	Gallons Acid Used	Type Acid	Gauge Cu. Ft./Day Before	Gauge Cu. Ft./Day After	% Increase	Cu. Ft. Increase per Gallon Acid	Cu. Ft. Increase per $ Acid	Cost Acid Compressor Water	T (
368	Phillips Pet. Co.	Pythian #1	Moore	23	44	H&TC	5/10/37	5,000	XX	25,000,000	45,101,000	80	4,020	20,640	974.61	1,3
374	Phillips Pet. Co.	E. W. Nelson #1	Moore	282		T&NO	5/28/37	5,000	XX	10,746,000	18,615,000	73	1,575	7,820	932.96	1,0
375	Phillips Pet. Co.	Mary Beth #1	Moore	17	M16	AB&M	6/ 4/37	5,000	XX	25,900,000	49,350,000	91	4,690	23,540	995.44	1,0
378	Phillips Pet. Co.	John Purdy #1	Moore	164	3T	T&NO	6/ 9/37	5,000	XX	27,700,000	46,678,000	69	3,797	19,070	995.44	1,0
386	Phillips Pet. Co.	Sturdy #1	Moore	24	M1	EL&R	6/23/37	10,000	XX	27,700,000	61,619,000	122	3,392	19,560	1,734.72	1,8
393	Phillips Pet. Co.	Stanley Marsh #1	Moore	316	44	H&TC	7/17/37	10,000	XX	16,000,000	56,000,000	250	4,000	23,060	1,734.72	1,8
396	Phillips Pet. Co.	Emily Nell #1	Moore	310	44	H&TC	7/24/37	10,000	XX	20,700,000	51,411,000	148	3,071	17,840	1,724.21	1,7
398	Shell Pet. Corp.	A. L. Miller #1	Moore	154	3T	T&NO	7/26/37	5,000	XX	23,200,000	30,930,000	33	1,546	8,280	932.96	1,0
390	Shamrock Oil & Gas	Mary Stewart #1	Hutch	19	M16	AB&M	7/10/37	10,000	XX	19,000,000	63,000,000	231	4,400	21,680	2,028.60	2,1
400	Shamrock Oil & Gas	C. R. Jones #1	Moore	166	3T	T&NO	7/31/37	15,000	XX	13,000,000	28,600,000	120	1,040	5,540	2,817.67	2,8
401	Shamrick Oil & Gas	J. T. Sneed #6	Moore	48	6T	T&NO	7/30/37	10,000	XX	12,000,000	81,000,000	575	6,900	36,940	1,868.52	2,4
402	Shamrock Oil & Gas	A. Sneed #1	Moore	32	6T	T&NO	7/23/37	4,000	XX	31,000,000	31,000,000	0	0	0	999.00	1,0
404	Canadian River Gas	Bivens A2	Moore	33	1	EL&RR	8/ 3/37	4,000	XX	7,000,000	46,357,000	562	9,839	42,350	929.04	1,2
399	Shamrock Oil & Gas	A. Sneed #2	Moore	21	6T	T&NO	7/20/37	10,000	XX	31,600,000	78,900,000	150	4,730	25,900	1,825.74	2,4
407	Shamrock Oil & Gas	J. T. Sneed #4	Moore	39	6T	T&NO	7/20/37	4,000	XX	7,500,000	7,500,000	0	0	0	819.00	8
405	Shamrock Oil & Gas	J. T. Sneed #7	Moore	3	M3	Wozier	8/ 7/37	4,000	XX	1,800,000	1,800,000	0	0	0	819.00	8
408	Shell Pet. Corp.	Hohman #1	Moore	227	3T	T&NO	8/15/37	5,000	XX	35,000,000	61,795,000	77	5,359	28,740	932.96	1,0
409	Cities Service Oil	Hoerner #1	Gray	217	213	H&CN	8/17/37	3,000	XX	3,000,000	7,800,000	160	1,600	8,230	583.10	6.
410	Shell Pet. Corp.	E. Miller A#1	Moore	146	3T	T&NO	8/18/37	5,000	XX	21,910,000	36,007,000	64	2,819	14,600	965.23	1,0
413	Phillips Pet. Co.	W. C. Stigall #1	Moore	280	44	H&TC	8/17/37	5,000	XX	31,700,000	80,179,000	159	10,100	54,100	932.96	1,0
415	Phillips Pet. Co.	Ada #1	Moore	151	3T	T&NO	8/19/37	10,000	XX	11,600,000	33,130,000	186	2,153	14,370	1,499.40	1,5
420	Shell Pet. Corp.	Lucas #1	Hutch	6		Swisher	8/26/37	5,000	X	13,000,000	24,835,000	91	2,367	12,700	932.96	1,0
423	Phillips Pet. Co.	W. Coffee #1	Moore	355	44	H&TC	8/30/37	5,000	XX	35,000,000	,4,518,000	113	7,900	42,350	932.96	1,0
426	Phillips Pet. Co.	R. H. Venable #1	Moore	203	3T	T&NO	9/ 2/37	5,000	XX	33,000,000	60,413,000	83	5,485	29,440	932.96	1,0
429	Shell Pet. Corp.	Ottis Phillips A#1	Hutch	2	M16	AB&M	9/10/37	5,000	XX	7,300,000	21,436,000	194	2,827	15,160	932.96	1,0
430	Phillips Pet. Co.	Texas #1	Moore	113	3T	T&NO	9/12/37	5,000	XX	42,100,000	63,197,000	50	4,206	22,620	932.96	1,0
434	Shamrock Oil & Gas	McDowell #1	Moore	13	M16	T&NO	9/13/37	10,000	XX	12,000,000	28,118,000	134	1,612	9,350	1,724.31	1,7
440	Shell Pet. Corp.	W. L. Russell #1	Moore	5	M16	AB&M	9/17/37	5,000	XX	6,885,000	13,168,000	91	1,257	6,730	932.96	1,0
441	Stanolind Oil & Gas Co.	C. Merchant #4	Hutch	38	47	H&TC	9/22/37	2,000	XX	3,000,000	6,800,000	126	2,530	12,020	376.00	4
444	Shell Pet. Corp.	Kraker #1	Moore	149	3T	T&NO	9/26/37	5,500	XX	8,314,000	17,335,000	108	1,640	8,090	1,117.50	1,1
446	Phillips Pet. Co.	Preston #1	Moore	278	44	H&TC	9/26/37	5,000	XX	11,600,000	17,261,000	49	1,132	6,097	932.96	1,2
448	Phillips Pet. Co.	Ray #1	Moore	199	3T	T&NO	9/29/37	5,000	XX	40,000,000	67,466,000	69	5,495	29,500	932.96	1,0
452	Shamrock Oil & Gas	J. T. Sneed #1	Moore	32	6T	T&NO	10/ 1/37	10,000	XX	28,537,000	41,305,000	45	1,277	7,265	1,758.46	2,3
455	Shamrock Oil & Gas	J. T. Sneed #8	Moore	41	6T	T&NO	10/ 5/37	10,000	XX	6,800,000	31,800,000	368	2,500	14,240	1,755.96	2,3
456	Phillips Pet. Co.	Nellie Loeber #1	Moore	35	2	CC&SF	10/ 6/37	10,000	XX	9,000,000	31,800,000	254	2,280	13,230	1,724.72	1,7
461	Phillips Pet. Co.	Oshner #1	Moore	278	44	H&TC	10/20/37	5,000	XX	24,250,000	49,834,000	106	5,116	27,420	932.96	1,2
463	Panhandle Eastern Pipe Line Co.	Masterson 1-38	Moore	38	3	G&M	10/21/37	10,000	XX	6,350,000	31,524,000	396	2,517	11,960	2,102.10	2,4
465	Shamrock Oil & Gas	Sneed #9	Moore	8	M1	Morrison	11/ 4/37	10,000	XX	9,000,000	78,880,000	777	6,988	40,525	1,724.31	2,3
468	Panhandle Eastern Pipe Line Co.	Neild #1	Moore	18	44	H&TC	11/ 4/37	2,000	XX	7,000,000	34,000,000	386	13,500	50,300	465.50	5
469	Shamrock Oil & Gas	Thompson #1	Moore	23	44	H&TC	11/ 8/37	1,000	XX	18,000,000	18,000,000	0	0	0	238.00	3
470	Phillips Pet. Co.	Stanhope #1	Moore	231	3T	T&NO	11/13/37	10,000	XX	14,000,000	37,213,000	166	2,321	13,470	1,724.72	1,7
471	Shamrock Oil & Gas	Shary #1	Moore	187	3T	T&NO	11/17/37	3,000	XX	21,045,000	52,800,000	181	11,333	58,300	583.10	6
476	Shell Pet. Corp.	A. P. Wilbar #1	Moore	229	3T	T&NO	11/25/37	5,000	XX	9,000,000	14,421,000	60	1,084	5,820	932.96	1,0
477	Phillips Pet. Co.	R. Ansley #1	Moore	308	44	H&TC	4/28/37	10,000	XX	16,000,000	47,201,000	195	3,120	18,100	1,724.72	1,7
479	Shamrock Oil & Gas	Sneed #11	Moore	29	6T	T&NO	12/ 4/37	6,000	XX	9,000,000	18,000,000	100	1,500	15,000	1,156.00	1,3
483	Phillips Pet. Co.	C. R. Jenes A#3	Moore	164	3T	T&NO	12/ 4/37	5,000	XX	7,000,000	25,242,000	261	3,648	19,570	932.96	1,0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Cu. Ft. Increase per $ Acid	Cost Acid Compressor Water	Total Cost	Increased Revenue/ Month	Pay Out in Months	Type Well
20,640	974.61	1,306.61	656.00	2.0	Sweet
7,820	932.96	1,004.96	20.50	49.0	Sour
23,540	995.44	1,067.44	60.93	17.5	Sour
19,070	995.44	1,067.44	49.50	21.6	Sour
19,560	1,734.72	1,806.72	88.40	20.4	Sour
23,060	1,734.72	1,806.72	104.20	17.3	Sour
17,840	1,724.21	1,796.21	80.00	22.5	Sour
8,280	932.96	1,004.96	20.12	50.0	Sour
21,680	2,028.60	2,100.60	114.70	18.3	Sour
5,540	2,817.67	2,889.67	40.60	73.7	Sour
36,940	1,868.52	2,460.52	2,264.00	1.1	Sweet
0	999.00	1,071.00	0	—	Sweet
42,350	929.04	1,261.04	1,291.00	1.0	Sweet
25,900	1,825.74	2,417.74	1,551.00	1.6	Sweet
0	819.00	881.00	0	—	Sweet
0	819.00	881.00	0	—	Sweet
28,740	932.96	1,004.96	69.97	14.4	Sour
8,230	583.10	655.10	147.60	3.9	Sweet
14,600	965.23	1,037.23	36.70	28.2	Sour
54,100	932.96	1,004.96	126.10	8.0	Sour
14,370	1,499.40	1,571.40	56.05	28.1	Sour
12,700	932.96	1,004.96	30.90	32.5	Sour
42,350	932.96	1,004.96	103.00	9.8	Sour
29,440	932.96	1,004.96	71.80	14.0	Sour
15,160	932.96	1,004.96	36.80	27.3	Sour
22,620	932.96	1,004.96	54.90	18.3	Sour
9,350	1,724.31	1,796.31	41.90	42.8	Sour
6,730	932.96	1,004.96	16.37	61.4	Sour
12,020	376.00	448.00	32.20	14.0	Sour
8,090	1,117.50	1,189.50	23.46	50.7	Sour
6,097	932.96	1,264.96	185.40	6.8	Sweet
29,500	932.96	1,004.96	71.43	14.1	Sour
7,265	1,758.46	2,350.46	418.00	5.6	Sweet
14,240	1,755.96	2,347.96	820.0	2.9	Sweet
13,230	1,724.72	1,796.72	58.0	30.9	Sour
27,420	932.96	1,264.96	841.00	1.5	Sweet
11,960	2,102.10	2,434.10	757.50	3.2	Sweet
40,525	1,724.31	2,316.31	2,293.00	1.0	Sweet
50,300	465.50	537.50	885.80	.6	Sweet
0	238.00	310.00	0	—	Sweet
13,470	1,724.72	1,796.72	60.50	29.7	Sour
58,300	583.10	655.00	82.75	7.9	Sour
5,820	932.96	1,004.96	14.14	7.1	Sour
18,100	1,724.72	1,796.72	81.30	22.1	Sour
15,000	1,156.00	1,300.00	295.00	4.4	Sweet
19,570	932.96	1,004.96	47.53	21.1	Sour
0	932.96	1,004.96	0	—	Sweet

378	Phillips Pet. Co.	[illegible] #1	Moore	164	31	T&NO	6/ 9/37	5,000	XX	27,700,000	46,678,000	69	3,797	19,070
386	Phillips Pet. Co.	Sturdy #1	Moore	24	M1	EL&R	6/23/37	10,000	XX	27,700,000	61,619,000	122	3,392	19,560
393	Phillips Pet. Co.	Stanley Marsh #1	Moore	316	44	H&TC	7/17/37	10,000	XX	16,000,000	56,000,000	250	4,000	23,060
396	Phillips Pet. Co.	Emily Nell #1	Moore	310	44	H&TC	7/24/37	10,000	XX	20,700,000	51,411,000	148	3,071	17,840
398	Shell Pet. Corp.	A. L. Miller #1	Moore	154	3T	T&NO	7/26/37	5,000	XX	23,200,000	30,930,000	33	1,546	8,280
390	Shamrock Oil & Gas	Mary Stewart #1	Hutch	19	M16	AB&M	7/10/37	10,000	XX	19,000,000	63,000,000	231	4,400	21,680
400	Shamrock Oil & Gas	C. R. Jones #1	Moore	166	3T	T&NO	7/31/37	15,000	XX	13,000,000	28,600,000	120	1,040	5,540
401	Shamrick Oil & Gas	J. T. Sneed #6	Moore	48	6T	T&NO	7/30/37	10,000	XX	12,000,000	81,000,000	575	6,900	36,940
402	Shamrock Oil & Gas	A. Sneed #1	Moore	32	6T	T&NO	7/23/37	4,000	XX	31,000,000	31,000,000	0	0	0
404	Canadian River Gas	Bivens A2	Moore	33	1	EL&RR	8/ 3/37	4,000	XX	7,000,000	46,357,000	562	9,839	42,350
399	Shamrock Oil & Gas	A. Sneed #2	Moore	21	6T	T&NO	7/20/37	10,000	XX	31,600,000	78,900,000	150	4,730	25,900
407	Shamrock Oil & Gas	J. T. Sneed #4	Moore	39	6T	T&NO	7/20/37	4,000	XX	7,500,000	7,500,000	0	0	0
405	Shamrock Oil & Gas	J. T. Sneed #7	Moore	3	M3	Wozier	8/ 7/37	4,000	XX	1,800,000	1,800,000	0	0	0
408	Shell Pet. Corp.	Hohman #1	Moore	227	3T	T&NO	8/15/37	5,000	XX	35,000,000	61,795,000	77	5,359	28,740
409	Cities Service Oil	Hoerner #1	Gray	217	213	H&CN	8/17/37	3,000	XX	3,000,000	7,800,000	160	1,600	8,230
410	Shell Pet. Corp.	E. Miller A#1	Moore	146	3T	T&NO	8/18/37	5,000	XX	21,910,000	36,007,000	64	2,819	14,600
413	Phillips Pet. Co.	W. C. Stigall #1	Moore	280	44	H&TC	8/17/37	5,000	XX	31,700,000	80,179,000	159	10,100	54,100
415	Phillips Pet. Co.	Ada #1	Moore	151	3T	T&NO	8/19/37	10,000	XX	11,600,000	33,130,000	186	2,153	14,370
420	Shell Pet. Corp.	Lucas #1	Hutch	6		Swisher	8/26/37	5,000	X	13,000,000	24,835,000	91	2,367	12,700
423	Phillips Pet. Co.	W. Coffee #1	Moore	355	44	H&TC	8/30/37	5,000	XX	35,000,000	74,518,000	113	7,900	42,350
426	Phillips Pet. Co.	R. H. Venable #1	Moore	203	3T	T&NO	9/ 2/37	5,000	XX	33,000,000	60,413,000	83	5,485	29,440
429	Shell Pet. Corp.	Ottis Phillips A#1	Hutch	2	M16	AB&M	9/10/37	5,000	XX	7,300,000	21,436,000	194	2,827	15,160
430	Phillips Pet. Co.	Texas #1	Moore	113	3T	T&NO	9/12/37	5,000	XX	42,100,000	63,197,000	50	4,206	22,620
434	Shamrock Oil & Gas	McDowell #1	Moore	13	M16	T&NO	9/13/37	10,000	XX	12,000,000	28,118,000	134	1,612	9,350
440	Shell Pet. Corp.	W. L. Russell #1	Moore	5	M16	AB&M	9/17/37	5,000	XX	6,885,000	13,168,000	91	1,257	6,730
441	Stanolind Oil & Gas Co.	C. Merchant #4	Hutch	38	47	H&TC	9/22/37	2,000	XX	3,000,000	6,800,000	126	2,530	12,020
444	Shell Pet. Corp.	Kraker #1	Moore	149	3T	T&NO	9/26/37	5,500	XX	8,314,000	17,335,000	108	1,640	8,090
446	Phillips Pet. Co.	Preston #1	Moore	278	44	H&TC	9/26/37	5,000	XX	11,600,000	17,261,000	49	1,132	6,097
448	Phillips Pet. Co.	Ray #1	Moore	199	3T	T&NO	9/29/37	5,000	XX	40,000,000	67,466,000	69	5,495	29,500
452	Shamrock Oil & Gas	J. T. Sneed #1	Moore	32	6T	T&NO	10/ 1/37	10,000	XX	28,537,000	41,305,000	45	1,277	7,265
455	Shamrock Oil & Gas	J. T. Sneed #8	Moore	41	6T	T&NO	10/ 5/37	10,000	XX	6,800,000	31,800,000	368	2,500	14,240
456	Phillips Pet. Co.	Nellie Loeber #1	Moore	35	2	CC&SF	10/ 6/37	10,000	XX	9,000,000	31,800,000	254	2,280	13,230
461	Phillips Pet. Co.	Oshner #1	Moore	278	44	H&TC	10/20/37	5,000	XX	24,250,000	49,834,000	106	5,116	27,420
463	Panhandle Eastern Pipe Line Co.	Masterson 1-38	Moore	38	3	G&M	10/21/37	10,000	XX	6,350,000	31,524,000	396	2,517	11,960
465	Shamrock Oil & Gas	Sneed #9	Moore	8	M1	Morrison	11/ 4/37	10,000	XX	9,000,000	78,880,000	777	6,988	40,525
468	Panhandle Eastern Pipe Line Co.	Neild #1	Moore	18	44	H&TC	11/ 4/37	2,000	XX	7,000,000	34,000,000	386	13,500	50,300
469	Shamrock Oil & Gas	Thompson #1	Moore	23	44	H&TC	11/ 8/37	1,000	XX	18,000,000	18,000,000	0	0	0
470	Phillips Pet. Co.	Stanhope #1	Moore	231	3T	T&NO	11/13/37	10,000	XX	14,000,000	37,213,000	166	2,321	13,470
471	Shamrock Oil & Gas	Shary #1	Moore	187	3T	T&NO	11/17/37	3,000	XX	21,045,000	52,800,000	181	11,333	58,300
476	Shell Pet. Corp.	A. P. Wilbar #1	Moore	229	3T	T&NO	11/25/37	5,000	XX	9,000,000	14,421,000	60	1,084	5,820
477	Phillips Pet. Co.	R. Ansley #1	Moore	308	44	H&TC	4/28/37	10,000	XX	16,000,000	47,201,000	195	3,120	18,100
479	Shamrock Oil & Gas	Sneed #11	Moore	29	6T	T&NO	12/ 4/37	6,000	XX	9,000,000	18,000,000	100	1,500	15,000
483	Phillips Pet. Co.	C. R. Jones A#3	Moore	164	3T	T&NO	12/ 4/37	5,000	XX	7,000,000	25,242,000	261	3,648	19,570
486	Texoma Nat. Gas Co.	W. G. Deahl #1	Hutch	3	3	AB&M	12/27/37	5,000	XX	6,300,000	6,300,000	0	0	0
487	Texoma Nat. Gas Co.	Texas Fee #3	Carson	59	4	I&GN	12/29/37	4,000	XX	7,598,000	7,598,000	0	0	0
488	Shell Pet. Corp.	E. R. Longanecker #1	Moore	150	3T	T&NO	1/ 1/38	8,000	XX	3,800,000	16,500,000	334	1,588	9,033
489	Phillips Pet. Co.	Clark Gable #2	Moore	356	44	H&TC	1/ 1/38	5,000	XX	6,800,000	27,562,000	306	4,152	22,260
490	Shamrock Oil & Gas	Sneed #10	Moore	49	6T	T&NO	1/ 4/38	6,000	XX	80,000,000	136,000,000	70	9,333	51,300
492	Carl M. Smith & J. R. Roby	Meers #1	Gray	107	3	I&GN	1/ 6/38	1,000	XX	1,500,000	1,500,000	0	0	0
493	Cities Service Oil	Deahl #8	Carson	6	B	AB&M	1/12/38	9,000	XX	2,480,000	7,820,000	315	869	3,220
496	Sinclair Prairie Oil Co.	Merchant Vacuum #5	Hutch	37	47	H&TC	1/24/38	5,000	XX	16,000,000	30,669,000	92	3,200	17,150
497	Shamrock Oil & Gas	Kelly #1	Moore	212	3T	H&TC	1/24/38	4,000	XXF	21,000,000	47,500,000	126	6,620	31,980
500	Phillips Pet. Co.	Shellburg #1	Moore	110	3T	T&NO	2/ 3/38	10,000	X	4,760,000	6,886,000	45	213	1,424
503	Texhoma Nat. Gas Co.	Texas Fee #3	Carson	59	4	I&GN	3/ 8/38	5,000	X	6,000,000	11,338,000	89	1,068	6,050
506	Texhoma Nat. Gas Co.	Deahl E#1	Hutch	3	3	AB&M	3/23/38	5,000	X	6,300,000	9,786,000	55	872	4,317
507	Phillips Pet. Co.	J. F. Ward #1	Moore	320	44	H&TC	4/11/38	5,000	X	22,040,000	35,960,000	63	2,284	17,240
511	Phillips Pet. Co.	C. R. Jones #1	Moore	164	3T	T&NO	5/ 9/38	5,000	X	4,690,000	38,698,000	726	6,801	42,140
526	Phillips Pet. Co.	Jones 696 #1	Moore	189	3T	T&NO	5/23/38	5,000	XXF	6,650,000	33,300,000	401	5,330	28,570
527	Phillips Pet. Co.	R. D. Fields #1	Moore	247	3T	HT&BRR	5/24/38	5,000	XF	2,280,000	16,147,000	608	2,773	17,170
537	Phillips Pet. Co.	Makeig #1	Moore	309	44	H&TC	7/11/38	5,000	XFR	25,600,000	65,814,000	157	8,043	49,770
538	Canadian River Gas	Bivens A#15	Moore	76	2	G&M	7/13/38	5,000	XR	8,872,000	9,558,000	8	172	1,043
530	Phillips Pet. Co.	J. Lane #1	Hutch	3	B3	D&SE	6/15/38	700	XX	2,043,000	4,900,000	140	4,080	14,780
535	Phillips Pet. Co.	Garland #2	Hutch	77	46	H&TC	6/30/38	1,600	XX	5,500,000	7,400,000	35	1,187	5,616

19,0[illegible]					
19,560	1,734.72	1,806.72	88.40	20.4	Sour
23,060	1,734.72	1,806.72	104.20	17.3	Sour
17,840	1,724.21	1,796.21	80.00	22.5	Sour
8,280	932.96	1,004.96	20.12	50.0	Sour
21,680	2,028.60	2,100.60	114.70	18.3	Sour
5,540	2,817.67	2,889.67	40.60	73.7	Sour
36,940	1,868.52	2,460.52	2,264.00	1.1	Sweet
0	999.00	1,071.00	0	—	Sweet
42,350	929.04	1,261.04	1,291.00	1.0	Sweet
25,900	1,825.74	2,417.74	1,551.00	1.6	Sweet
0	819.00	881.00	0	—	Sweet
0	819.00	881.00	0	—	Sweet
28,740	932.96	1,004.96	69.97	14.4	Sour
8,230	583.10	655.10	147.60	3.9	Sweet
14,600	965.23	1,037.23	36.70	28.2	Sour
54,100	932.96	1,004.96	126.10	8.0	Sour
14,370	1,499.40	1,571.40	56.05	28.1	Sour
12,700	932.96	1,004.96	30.90	32.5	Sour
42,350	932.96	1,004.96	103.00	9.8	Sour
29,440	932.96	1,004.96	71.80	14.0	Sour
15,160	932.96	1,004.96	36.80	27.3	Sour
22,620	932.96	1,004.96	54.90	18.3	Sour
9,350	1,724.31	1,796.31	41.90	42.8	Sour
6,730	932.96	1,004.96	16.37	61.4	Sour
12,020	376.00	448.00	32.20	14.0	Sour
8,090	1,117.50	1,189.50	23.46	50.7	Sour
6,097	932.96	1,264.96	185.40	6.8	Sweet
29,500	932.96	1,004.96	71.43	14.1	Sour
7,265	1,758.46	2,350.46	418.00	5.6	Sweet
14,240	1,755.96	2,347.96	820.0	2.9	Sweet
13,230	1,724.72	1,796.72	58.0	30.9	Sour
27,420	932.96	1,264.96	841.00	1.5	Sweet
11,960	2,102.10	2,434.10	757.50	3.2	Sweet
40,525	1,724.31	2,316.31	2,293.00	1.0	Sweet
50,300	465.50	537.50	885.80	.6	Sweet
0	238.00	310.00	0	—	Sweet
13,470	1,724.72	1,796.72	60.50	29.7	Sour
58,300	583.10	655.00	82.75	7.9	Sour
5,820	932.96	1,004.96	14.14	7.1	Sour
18,100	1,724.72	1,796.72	81.30	22.1	Sour
15,000	1,156.00	1,300.00	295.00	4.4	Sweet
19,570	932.96	1,004.96	47.53	21.1	Sour
0	932.96	1,004.96	0	—	Sweet
0	758.03	830.03	0	—	Sweet
9,033	1,407.77	1,479.77	33.10	44.7	Sour
22,260	932.96	1,004.96	48.33	20.6	Sour
51,300	1,091.23	1,683.23	1,837.00	.9	Sweet
0	274.40	346.40	0	—	Sour
3,220	1,842.40	2,434.4	235.30	10.3	Sweet
17,150	932.96	1,004.96	38.20	26.3	Sour
31,980	758.03	830.03	68.75	12.1	Sour
1,424	1,495.24	1,567.24	5.54	283.3	Sour
6,050	808.01	1,400.01	174.80	8.0	Sweet
4,317	808.01	1,400.01	117.70	11.9	Sweet
17,240	808.01	880.01	36.17	24.3	Sour
42,140	808.01	880.01	88.50	10.0	Sour
28,570	932.96	1,004.96	69.11	14.5	Sour
17,170	808.01	880.01	36.00	24.4	Sour
49,770	808.01	880.01	104.50	8.4	Sour
1,043	658.07	1,250.67	22.33	5.6	Sweet
14,780	193.26	265.26	7.44	35.6	Sour
5,616	338.20	410.20	4.96	82.7	Sour

PLAINTIFF'S EXHIBIT 330

97 CONSECUTIVE ARBUCLE DOLOMITE WELLS TREATED BY DOWELL INCORPORATED IN KANSAS FROM MARCH TO SEPT. 1936 TOTALING 122 TREATMENTS

Tmt. No.	Owner of Well	Well Name & No.	Time Acid Was in Tubing/Hrs.	Add. Tmt. No.	Time Acid Was in Tubing/hrs	Total Time/Hrs Acid in Tubing
1802	Empire Oil & Ref.	Anderson #5	33:05	1605	20:00	53:05
1803	Empire Oil & Ref.	Kirkpatrick #5	6:55			6:55
1804	Sinclair	Kelly #1	3:00			3:00
1805	Continental Oil	J. L. Lansing #2	1:15			1:15
1807	Gulf Oil Corp.	Coffman #5	3:09			3:09
1808	Helmerick & Payne	H. L. Wartick #1	9:15	1760	2:55	12:10
1809	Gulf Oil Corp.	Keesling #4	23:25	1837	3:17	
				1868	6:28	33:10
1810	Sinclair	Sharp #5	1:53			1:53
1814	Gulf Oil Corp.	Knop #1	3:08			3:08
1815	Bradley Oil Co.	Wendell #2	2:00			2:00
1816	Empire Oil & Ref.	Burns #2	1:45			1:45
1818	Stanolind Oil & Gas	Figgers #1	29:30			29:30
1819	Mid-Continent Pet.	Hartle #7	0:30			0:30
1820	Skelly Oil Co.	Graham #4	0:45			est. 0:45
1822	Shell Ref. Co.	Community #4	1:25	1852	1:35	3:00
1824	Continental Oil	Gibson AFE 5541	1:53			1:53
1827	Continental Oil	Risse #11AFE 551	2:19			2:19
1828	Sinclair	Cross #1	5:45			5:45
1829	Carter Oil Co.	Groth #2	1:11			1:11
1830	Lario Oil & Gas	Boxberger #3	1:29	1652	1:12	2:41
1831	Hutchinson Oil & Gas	Wendell #5	3:48			3:48
1846	Continental Oil	Risse #10	1:35			1:35
1854	Continental Oil	Westerman #1	1:25			1:25
1855	Carter Oil Co.	Ogden #4	1:35			1:35
1857	Stanolind Oil & Gas	Eberhart #1	5:30			5:30
1859	Empire Oil & Ref.	Young #1	41:08	1876	11:55	
				1884	2:10	55:13
1860	Buchanan Tst.	Lancefield #1	7:05			7:05
1865	W. T. Southern	R. Berry #2	1:04			1:04
1875	Continental Oil	Ainsworth #2	4:20			4:20
1878	Coralena Oil Co.	Boomhower #1	5:20			5:20
1881	Stanolind Oil & Gas	Mitchell #5	9:53	1978	3:43	13:36
1883	Continental Oil	J. Jones #1	1:03			1:03
1885	Sinclair Prairie	Iserm #2	6:30	1904	12:00	
				1919	17:47	36:16
1886	Gulf Oil Corp.	Hartle #6	5:26	1928	3:02	8:28
1890	Empire Oil & Ref.	Janssen #1B	3:50	1912	3:50	7:40
1900	Empire Oil & Ref.	Burns #3	1:40	1917	1:35	3:15
1908	Skelly Oil Co.	Ehrlich #1	1:00			1:00
1909	Skelly Oil Co.	C. O. Sharp #2	1:15			1:15
1910	Empire Oil & Ref.	Proffitt #12	6:00	1940	2:15	8:15
1924	Shell Pet. Co.	Emrich #14	7:40			7:40
1926	Empire Oil & Ref.	Manning #11	43:32			43:32
1927	Mid-Continent Pet.	Motzek #6	1:15			1:15
1929	Continental Oil	Risse #13	1:50			1:50
1930	Slick Pryor & Lockhart	Habiger #B1	1:30			1:30
1932	Continental Oil	Risse #12	1:22			1:22
1936	Herndon Drg. Co.	Smith #2	7:30	1954	3:33	11:03
1938	Hinerman & Skiles	Edwards #1	2:03			2:03
1942	Yarnell-Carlson Oil	Bloomer #1	2:51			2:51
1943	W. I. Southern	Shaffer #2	2:15			2:15
1948	Texas Co.	Moran #2	1:50			1:50

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1938	Hinerman & Skiles	Edwards #1	2:03			2:03
1942	Yarnell-Carlson Oil	Bloomer #1	2:51			2:51
1943	W. I. Southern	Shaffer #2	2:15			2:15
1948	Texas Co.	Moran #2	1:50			1:50
1950	Empire Oil & Ref.	Janssen #3	8:30	1985	18:53	27:23
1955	Gulf Oil Corp.	Malone #3	7:46			7:46
1961	Stanolind Oil & Gas	Richardson #1	1:12			1:12
1968	Empire Oil & Ref.	Sifers #1	5:24	1994	18:00	23:24
1969	Sinclair	Sharp #6	4:12			4:12
1970	Phillips Pet.	Winteer #1	10:56			10:56
1971	Phillips Pet.	Bertha #1	4:24			4:24
1972	Shell Pet. Co.	Brown #1	4:04			4:04
1974	Stanolind Oil & Gas	Roesner #1	2:40			2:40
1976	Sinclair	Isern #1	3:05	1687	3:05	
				1719	2:21	8:31
1986	W. I. Southern	M. Weeks #1	2:54			2:54
1989	Phillips	Krampe #11	2:08			2:08
1990	Empire Oil & Ref.	Batman #19	14:55			14:55
1991	W. I. Southern	Sellens Heirs #2	3:22			3:22
1992	Gulf Oil Corp.	Zahorsky #2	0:15			0:15
1995	Simpson Oil Co.	Bowman #1	21:59	2013	5:05	27:04
1996	Stanolind Oil & Gas	Banning #1	2:02			2:02
1997	Empire Oil & Ref.	Boxberger #1	4:00			4:00
1998	W. I. Southern	Sellens Heirs #3	6:12			6:12
2001	Carter Oil Co.	Mollhagen #1	3:20			3:20
2014	Phillips Pet. Co.	Matzek #5	0:58			0:58
2016	Skelly Oil Co.	M. Figgins #2	17:02			17:02
2022	W. I. Southern	C. W. Shaffer #3	2:18			2:18
2024	Coralena Oil Co.	Trapp #2	1:20			1:20
2027	Sinclair Prairie	Berrick #1	29:20			29:20
2031	Coralena Oil Co.	Boombower #2	7:57			7:57
2033	Simpson Oil Co.	Eberhart #2	31:40			31:40
2034	Stanolind Oil & Gas	O. L. Smith #3	3:20			3:20
2035	Carter Oil Co.	Ogden #5	0:47	1987	2:50	3:37
2037	Gulf Oil Corp.	Dick #4	3:38			3:38
2040	Gulf Oil Corp.	Zahorsky #1	3:32			3:32
2041	Empire Oil & Ref.	Janssen #2B	9:10			9:10
2046	Empire Oil & Ref.	Varner #27	46:15			46:15
2052	Empire Oil & Ref.	Kirkpatrick #1	9:40			9:40
2053	Coralena Oil Co.	Trapp #3	2:05			2:05
2065	Shell Pet. Corp.	Tobias #1	6:04	2080	25:23	31:27
2069	W. I. Southern	C. W. Shaffer #4	2:11			2:11
2066	Texas Co.	Anton Ruder #1	3:44	2079	4:20	8:04
2077	Shell Pet. Corp.	Sherman B#2	5:13			5:13
2081	Empire Oil & Ref.	Boyer #16	5:15			5:15
2084	Republic Nat. Gas	McLean #1	2:43			2:43
2087	Empire Oil & Ref.	Janssen #4A	33:10			33:10
2088	Republic Nat. Gas	Bloomer #1	2:45			2:45
2089	Carter Oil Co.	Teubner #7	1:35			1:35
2091	Texas Co.	Anton Ruder #1	2:11	drilled deeper since 2066		2:11
2092	Phillips Pet. Co.	S. Price #1	1:54			1:54
2093	Gulf Oil Corp.	Swires #2	1:56			1:56
2094	Coralena Oil Corp.	Trapp #4	1:28			1:28
						802 hr. 3207 m.

97 Consecutive Arbucle Dolomite Wells
Treated by Dowell in Kansas from March to

2041	Empire Oil & Ref.	Janssen #2B	9:10			9:10
2046	Empire Oil & Ref.	Varner #27	46:15			46:15
2052	Empire Oil & Ref.	Kirkpatrick #1	9:40			9:40
2053	Coralena Oil Co.	Trapp #3	2:05			2:05
2065	Shell Pet. Corp.	Tobias #1	6:04	2080	25:23	31:27
2069	W. I. Southern	C. W. Shaffer #4	2:11			2:11
2066	Texas Co.	Anton Ruder #1	3:44	2079	4:20	8:04
2077	Shell Pet. Corp.	Sherman B#2	5:13			5:13
2081	Empire Oil & Ref.	Boyer #16	5:15			5:15
2084	Republic Nat. Gas	McLean #1	2:43			2:43
2087	Empire Oil & Ref.	Janssen #4A	33:10			33:10
2088	Republic Nat. Gas	Bloomer #1	2:45			2:45
2089	Carter Oil Co.	Teubner #7	1:35			1:35
2091	Texas Co.	Anton Ruder #1	2:11	drilled deeper since 2066		2:11
2092	Phillips Pet. Co.	S. Price #1	1:54			1:54
2093	Gulf Oil Corp.	Swires #2	1:56			1:56
2094	Coralena Oil Corp.	Trapp #4	1:28			1:28
						802 hr. 3207 m.

97 Consecutive Arbucle Dolomite Wells
Treated by Dowell in Kansas from March to
September 1936. Totaling 122 Treatments.

Average Gallonage	=	1089.5 Gallons
Average Maximum Treating Pressure	=	528 P.S.I.
Average Time Acid in Tubing	=	7 hr. 1 mi.
Average internal diameter of tubing shown in these treatments	=	2.66 in.
Average length of tubing shown in these treatments	=	3211 ft.

Internal surface area of tubing with an Internal Diameter of 2.66 in.

$$= \frac{2.66 \times 3.1416}{12} = .692 \text{ Square feet per foot,}$$

of length or 692 square feet per 1000 ft. of length.
692 x 3.211 = 2241 square feet = average internal surface of tubing in these treatments.

PLAINTIFF'S EXHIBIT 331

Average time for 122 treatments—7 hrs. 1 min.

18 treatments 12 hrs. or over—14.75% of total

35 treatments 6 hrs. or over—26.68% of total

PLAINTIFF'S EXHIBIT 337

Chart Showing Combinations Possible Under Claims of Gravell 1,678,775

The Gravell claims are of such scope as to cover the use of the metals here listed, either alone combination with any acid regulator for the protection of iron or steel storage or transporta- drums against corrosion by acids.

Acids Corrosive Iron or Steel	Common Metals Within Range Specified by Gravell	Acid Regulators Listed by Gravell—with Approximate Number of Compounds Under Each Class Indicated
Acetic	1. Antimony	1. Acid Resins—8 or More
Butyric	2. Arsenic	2. Alcohols—676 Commonly Listed, Including
Formic	3. Bismuth	3. Amyl—8 or More
Hydriodic	4. Cadmium	4. Butyl—4 or More
Hydrobromic	5. Cobalt	5. Ethyl
Hydrochloric	6. Copper	6. Methyl
Hydrofluoric	7. Lead	7. Propyl
Hydrofluosilicic	8. Nickel	8. Higher Alcohols—Large Number
Lactic	9. Thallium	9. Aldehydes—84 Commonly Listed
Monochloroacetic	10. Tin	10. Cellulose Pulp Waste—Comprises Many Different Compounds
Nitric		11. Crude Anthracene
Perchloric		12. Cyanides—91 Inorganic and 87 Organic Commonly Listed
Phosphoric		13. Distillate from Gelatine
Sulphuric		14. Distillate from Gelatine with Fats
		15. Gelatine
		16. Glycerine
		17. Hydrocarbon Tars—Many Hundreds, Number Indefinite
		18. Liquid Obtained from Bran
		19. Liquid Obtained from Starchy Material—Number Indefinite
		20. Nitrogen Ring Compounds—Many Thousands 2290 Parent Ring System and 1720 Pyrols Already Identified
		21. Organic Bases—Meaning Indefinite Over 1000 Commonly Listed
		22. Pyridine Bases—More Than 700 Commonly Listed
		23. Remains from Distillation of Anthracene
		24. Residues from Distillation of Organic Compounds —Indefinite Number—May Include Thousands
		25. Residues from Production of Naphthalene
		26. Sodium Bisulphate
		27. Sulphite Lye
		28. Sumac Leaves
		29. Waste Acids from Refining Hydrocarbons—Number and Meaning Indefinite—May Include Thousands

PLAINTIFF'S EXHIBIT 343

ALQUIST'S TABLES

Rate of Corrosion of Mild Steel in Various Concentrations of Hydrochloric Acid Solutions Containing 0.0043%, 0.102%, 1.32%, and 4.0% Copper Chloride

(Tests made at 35°C. for 16 hours)

Acid Solution	% Copper Chloride	Corrosion Rate Lbs. Lost/Sq. Ft./Day	% Corrosiveness
5% Hydrochloric Acid	0.0	0.174	100
"	0.0043	0.109	62.7
"	0.102	0.119	68.3
"	1.32	0.225	129
"	4.00	0.585	336
10% Hydrochloric Acid	0.0	0.190	100
"	0.0043	0.107	56.3
"	0.102	0.109	57.3
"	1.32	0.221	116
"	4.0	0.401	211
15% Hydrochloric Acid	0.0	0.263	100
"	0.0043	0.099	37.5
"	0.102	0.105	39.9
"	1.32	0.208	79.1
"	4.0	0.240	90.5
20% Hydrochloric Acid	0.0	0.547	100
"	0.0043	0.110	20.1
"	0.102	0.102	18.7
"	1.32	0.202	36.9
"	4.0	0.279	51.0
25% Hydrochloric Acid	0.0	1.33	100
"	0.0043	0.097	7.3
"	0.102	0.107	8.0
"	1.32	0.201	15.1
"	4.00	0.356	26.8
31.45% Hydrochloric Acid (20°Be′)	0.0	1.41	100
"	0.0043	0.106	7.5
"	0.102	0.135	9.6
"	1.32	0.139	9.9
"	4.00	0.292	20.7
35% Hydrochloric Acid	0.0	0.656	100
"	0.0043	0.328	50
"	0.102	0.172	26.2
"	1.32	0.177	27.0
"	4.00	0.216	32.9

PLAINTIFF'S EXHIBIT 344

Corrosion Accelerated by the Addition of a Gravell Metal to a 31.45% Hydrochloric Acid Solution (20°Be′) Containing the Acid Regulator Indicated

(Tests made at 35°C. for 16 hours)

No. on Graph	Acid	Acid Regulator	Metal	Corrosion Rate Lbs. Lost/ Sq. Ft./Day	% Corrosiveness
1	31.45% Hydrochloric Acid (20°Be′)	0.1% HCl Bone Oil Extract	—	0.5834	100
2	"	"	0.228% Tin	1.189	193.2
3	"	"	0.227% Cobalt	0.979	159.3
4	"	"	0.226% Nickel	0.7338	119.3
1	"	0.5% HCl Bone Oil Extract	—	0.3277	100
2	"	"	0.228% Tin	0.3606	110.3

PLAINTIFF'S EXHIBIT 347

DOWELL INCORPORATED

WELL TREATMENTS

	1932	1933	1934	1935	1936	1937	1938	1939	1940	Total
Total Treatments	59	1,121	1,988	2,144	3,057	4,764	3,850	4,241	5,522	26,746
Deductions:										
California Treatments*	0	0	0	0	2	32	91	48	42	215
Houston District—										
Mud Acid Treatments	0	0	0	0	0	0	3	93	241	337
Dow Chemical Treatments	0	2	0	0	3	5	7	3	21	41
Truck Rentals	0	0	0	1	25	34	51	88	148	347
Stuck Drill Pipe	0	0	4	20	31	23	6	21	28	133
Packer Seal Treatments	0	0	0	0	2	4	18	8	1	33
Scale Removal, Other Than California*(Not Known for 1932-1937)	..	..	..	..	..	..	0	0	6	6
	0	2	4	21	63	98	176	261	487	1,112
Net Total	59	1,119	1,984	2,123	2,994	4,666	3,674	3,980	5,035	25,634

*Eliminated because treatments in California were not in limestone formations.

PLAINTIFF'S EXHIBIT 348

Treatments Made by Licensees Other Than Dowell
This report does not include treatments made by California Licensees

Year	Number of Treatments
1934	38
1935	76
1936	256
1937	420
1938	406
1939	635
1940	446
	2,277

PLAINTIFF'S EXHIBIT 349

Summary of Royalty Charged by The Dow Chemical Co., Midland, Michigan

	1936	1937	1938	1939	1940
Quinlan Acid Service	105.00	5,008.22	4,328.67	7,241.86	6,070.98
Oil Well Cementing & Acid Corporation	537.75	2,132.03	532.06		
Morgan Acid Inc.		17,036.82	13,994.23	11,955.62	
Montana Acid Company			1,454.70	3,341.44	1,365.53
Ainsworth Well Treating Service			715.40	3,502.42	353.45
Western Incorporated				4,998.53	19,180.81
James G. Vandergrift				233.58	
Eline Acid Company					3,679.63
	642.75	24,177.07	21,025.06	31,273.45	30,650.40

Total $107,768.73

PLAINTIFF'S EXHIBIT 350

DOWELL INCORPORATED

Gallons of Inhibited Acid, Inhibitors and Surface Tension Reduction Agents

Year	Gallons Inhibited Acid	Gallons Inhibitors	Gallons Surface Tension Reduction Agents
Nov. 10 thru Dec. 31, 1932	84,950	155	
1933	1,220,757	6,738	
1934	2,297,254	5,249	1,622
1935	3,251,868	19,890	367
1936	7,059,407	42,339	2,781
1937	12,492,420	78,627	11,804
1938	10,170,863	42,641	12,897
1939	10,892,434	51,712	28,434
1940	15,113,754	77,249	48,585
	62,583,707	324,600	106,490

NOTE: Above figures form the basis for accompanying chart.

PLAINTIFF'S EXHIBIT 351

HALLIBURTON OIL WELL CEMENTING COMPANY
Acidizing Order and Data

8-2-1938

Owner Weber Oil Co.
Name of well Stella Wilcox #3 Invoicing Address Bay City Bank Bldg., Bay City, Michigan.
Sec. 34, Twp. 22 N. Range 2 E.

We authorize you to furnish 750 (Pen) gal. acid, other necessary materials equipment and to assist us in placing same in above well on 8-2-1938 at 9: A.M.

Preliminary Data

Casing size 5½" Weight 14# Set at 2487' Cemented Yes
Tubing size 2" Perforations at 2638' Packer at 2492'
Formation Dundee Lime Pay 2482' 2648 streaked
T.D. 2648'
Amt. cleaned out — Theo. vol. of well 58 bbls. Bleeding —
Date Brought in 7-23-1938
I. P. Oil 10 bbls. approx.
Water in Well None Previous treatments No
Application of present treatment—Fill hole above packer and treat below packer—two stages (250 & 500)

Since it is necessary in work of this nature to depend largely on indicated conditions in a well, and there being natural uncertainties as to measurements and variations in the formations to be treated, it is expressly agreed:

(a) That Halliburton Oil Well Cementing Company makes no guarantee of the effectiveness of the materials to be used in the treatment of the well, nor of the results of the treatment.

(b) That it shall not be liable for any injury or damage to the well growing out of or resulting from the treatment of said well, or from the use of said equipment in doing said work.

(c) That Halliburton Oil Well Cementing Company only agrees to furnish the materials herein ordered and its equipment suitable for placing said materials in said well and two operators to assist in performing the work under the supervision of the owner of the well or his representative.

Weber Oil Co.
By W. L. Steelman

HALLIBURTON OIL WELL CEMENTING COMPANY
Acidizing Ticket

No. 8184 AT

Charge To Weber Oil Co. Date 8-2-1938

Mail Address Bay City Bank Bldg., Bay City, Michigan

Lease Stella Wilcox 3 Sec. 34 Twp. 22 N R. 2 E State Mich.

County or Pool Ogemaw Arrival 8:00 A.M. Howco Trucks No. 599

Gallonage Hired Trucks — Miles to Well 87

Oil Used Filling Well One bbl. Water removed before treatment None

How many pumps used One Time acid on bottom —

Pressure Records

Time	Vol. Acid In	Pressure Casing	Pressure Tubing
1st			
10:00 A.M.	Start	200#	0
10:05 A.M.	250 Gal	200	0
10:10 A.M.	350 Gal	150#	600#
10:25 A.M.	12 bbls. oil	150#	800#
2nd			
2:00 P.M.	Start	150#	0
2:05 P.M.	500 Gal.	150#	0
2:15 P.M.	10 bbls.	200#	200#
2:30 P.M.	18 bbls.	200#	800#

Flushing Oil Used:
1st 12 bbls 2nd 18 bbls. Pressure at end. Casing 1st 150#
2nd 200
Tubing 1st 800# 2nd 800#
Materials Used 750 gal. (Pen) Acid — 10 gal. blanket
Charges: Acid $172.50 Blanket — Total $172.50

The above job was done under the supervision of the owner, operator or his agent whose signature appears below:

Treater: (Signed) Carl A. Nicholas Owner of Well or Agent
Helper: W. G. Aspin W. L. Steelman
District: Michigan

The following information is urgently requested in order that we may be fully advised and to enable us to keep our standard of service up to the highest point:

Was the work of Acidizing Equipment satisfactory? Yes
Was the work of Acidizing Crew performed in a satisfactory manner? Yes.
Was the Acidizing job satisfactorily completed? Yes.

Owner of Well or Agent
W. L. Steelman

HALLIBURTON OIL WELL CEMENTING COMPANY

Acidizing Order and Data

Date 8-5-1938

Owner Weber Oil Co.
Name of Well Stella Wilcox # 3 Invoicing Address Bay City Bank Bldg., Bay City, Michigan.
Sec. 34 Twp. 22N Range 2 E.

We authorize you to furnish 2000 (Penetrating) gal. acid, other necessary materials equipment and to assist us in placing same in above well on 8-5-1938 (Date) at 9:30 A.M. (time).

Plaintiff's Exhibit 351

Preliminary Data

Casing size $5\frac{1}{2}''$ Weight 14# Set at 2487′ Cemented Yes
Tubing size 2″ Perforations at 2638′ Packer at 2492′
Formation Dundee Lime Pay 2492′ to 2638′ Streaked.
T.D. 2648′ P.B. No. Shot No
Amt. cleaned out — Theo. vol. of well 58 bbls. Bleeding —
Date brought in 7-23-1938
I.P. Oil 10 bbls per day Water — Gas —
P.P. Oil 40 bbls. " " Water — Gas —
Water in well None Previous treatments 8-2-1938
By H.O.W.C. Co.

two stages 250 & 500
Howco No. 8184 Materials used 750 gal. Acid. Time treating 55 min.

Max. pressures encountered 800#
Results: increased from 10 bbls. to 40 bbls. per day.
Application of present treatment: fill hole above packer & treat below packer

Since it is necessary in work of this nature to depend largely on indicated conditions in a well, and there being natural uncertainties as to measurements and variations in the formations to be treated, it is expressly agreed:

(a) That Halliburton Oil Well Cementing Company makes no guarantee of the effectiveness of the materials to be used in the treatment of the well, nor of the results of the treatment.

(b) That it shall not be liable for any injury or damage to the well growing out of or resulting from the treatment of said well, or from the use of said equipment in doing said work.

(c) That Halliburton Oil Well Cementing Company only agrees to furnish the materials herein ordered and its equipment suitable for placing said materials in said well and two operators to assist in performing the work under the supervision of the owner of the well or his representative.

Weber Oil Co.,
By W. L. Steelman

Plaintiff's Exhibit 351

HALLIBURTON OIL WELL CEMENTING COMPANY
ACIDIZING TICKET

No. 8185 AT

Charge To Weber Oil Co. Date 8-5-1938
Mail Address Bay City Bank Bldg., Bay City, Mich.
Lease Stella Wilcox Well 3 Sec. 34 Twp. 22N R.2E State Mich.
County or Pool Ogemaw Arrival 8:20 A.M. Howco Trucks No. 599
Trailers No. 54 Miles to Well 87
Oil used filling well None Water removed before treatment None
How many pumps used One Time acid on bottom 9:35 A.M.

Pressure Records

Time	Vol. Acid in	Pressure Casing	Pressure Tubing
9:30 A.M.	Start	0	0
9:35 A.M.	500 gal.	50#	15
9:40 A.M.	1000	100#	15
9:42 A.M.	1200	100#	100#
9:55 A.M.	2000	100#	400#
10:30 A.M.	15 bbls. oil	50#	700#
11:00 A.M.	25 " "	0	600#

Flushing oil used 25 bbls. pressure at end. Casing 0 Tubing 600#
Materials used 2000 gal. (Pen) Acid & 30 gal. blanket
Charges: Acid $350.00 Blanket — Total $350.00

The above job was done under the supervision of the owner, operator or his agent whose signature appears below:

Treater: Owner of Well or Agent:
Carl A. Nicholas W. L. Steelman
Helper: Aspin & Campbell District Michigan
The following information is urgently requested in order that we may be fully advised and to enable us to keep our standard of service up to the highest point:

Plaintiff's Exhibit 351

Was the work of Acidizing Equipment satisfactory? Yes.
Was the work of Acidizing Crew performed in a satisfactory manner? Yes.
Was the Acidizing job satisfactorily completed? Yes.

W. L. Steelman
Owner of Well or Agent.

HALLIBURTON OIL WELL CEMENTING COMPANY
ACIDIZING ORDER AND DATA

Date 8-19-1938

Owner Weber Oil Co.
Name of well R. Zahn #2 Invoicing Address: Bay City Bank Bldg., Bay City, Michigan
Sec. 34 Twp. 22 N. Range 2 E.

We authorize you to furnish 2000 (Pen) gal. acid, other necessary materials equipment and to assist us in placing same in above well on 8-19-1938 (Date) at 9:00 A.M. (time).

Preliminary Data

Casing size 5½ Weight 14# Set at 2532′ Cemented Yes
Tubing size 2″ Perforations at 2665′ Packer at 2538′
Formation Dundee Lime Pay 2550 to 2674 streaks
T.D. 2674 P.B. Yes Shot No
Amt. cleaned out — Theo. vol. of well 52 bbls Bleeding —
I.P. Oil 4 bbls. per day Water 5 gal. per day Gas
Source of water Pay Nearness to water —
Water in well Very little Previous treatments No
Howco No. — Materials used Time treating
Max. pressures encountered
Results
Application of present treatment: Load hole above packer and treat in three stages 250 — 500 & 1250 gal. Swab well after each treatment.

Since it is necessary in work of this nature to depend largely on indicated conditions in a well, and there being natural uncertainties as to measurements and variations in the formations to be treated, it is expressly agreed:

(a) That Halliburton Oil Well Cementing Company makes no guarantee of the effectiveness of the materials to be used in the treatment of the well, nor of the results of the treatment.

(b) That it shall not be liable for any injury or damage to the well growing out of or resulting from the treatment of said well, or from the use of said equipment in doing said work.

(c) That Halliburton Oil Well Cementing Company only agrees to furnish the materials herein ordered and its equipment suitable for placing said materials in said well and two operators to assist in performing the work under the supervision of the owner of the well or his representative.

Weber Oil Co.
By W. L. Steelman

HALLIBURTON OIL WELL CEMENTING COMPANY
Acidizing Ticket

No. 8188 AT

Charge to Weber Oil Co. Date: 8-19-1938
Mail Address Bay City Bank Bldg., Bay City, Mich.
Lease R. Zahn Well 2 Sec. 34 Twp. 22N R. 2E State Mich
County or Pool Ogemaw Arrival 8:30 A.M. Howco Trucks No. 614
Trailers No. 57 Hired Transport Trucks—Firm name —
Gallonage Hired Trucks — Miles to Well 85
Oil used filling well — Water removed before treatment 5 gal.
How many pumps used One Time acid on bottom 1st (not legible)
2nd 2:34 P.
3rd 6:35 P.

Pressure Records

Time	Vol. Acid in	Pressure Casing	Pressure Tubing
1st			
11:00 A.M.	Start	0	0
11:03 A.M.	250 gal.	25#	20
11:07 A.M.	5 bbls. oil	50#	500#
11:38 A.M.	11 bbls. oil	50#	500#
2nd			
2:30 P.M.	Start	25#	0
2:35 P.M.	500 gal.	50#	20
2:40 P.M.	8 bbls. oil	60#	300#
3:05 P.M.	16 bbls. oil	20#	600#
3rd			
6:30 P.M.	Start	50#	0
6:40 P.M.	909 gal.	100#	200#
7:00 P.M.	1250 gal.	100#	500#
8:45 P.M.	20 bbls. oil	0#	700#

Flushing Oil Used: 1st 11 bbls. 2nd 16 bbls. 3rd 20 bbls. pressure at end:
Casing 1st 50#, 2nd 20# 3rd 0 Tubing 1st 500#, 2nd 600# 3rd 700#.
Materials used 2000 gal. (Pen) acid 20 gal. blanket
Charges: Acid $350.00 Blanket $ — Total $350.00

The above job was done under the supervision of the owner, operator or his agent whose signature appears below:

Owner of Well or Agent
(Signed) W. L. Steelman

Treater:
Carl A. Nicholas (Anthony) District
Helper: Michigan
Campbell — (Swain)
The following information is urgently requested in order that we may be fully advised and to enable us to keep our standard of service up to the highest point:

Was the work of Acidizing Equipment satisfactory? Yes
Was the work of Acidizing Crew performed in a satisfactory manner? Yes
Was the Acidizing job satisfactorily completed Yes.

W. L. Steelman
Owner of Well or Agent.

HALLIBURTON OIL WELL CEMENTING COMPANY
Acidizing Order and Data

Date 9-10-1938

Owner Weber Oil Co.
Name of well Crawford #5 Invoicing Address Bay City Bank Bldg., Bay City, Michigan
Sec. 28 Twp. 22 N Range 2 E

We authorize you to furnish 2,000 (Klersol) gal. acid, other necessary materials equipment and to assist us in placing same in above well on 9-10-1938 (date) at 9:00 A.M. (time).

Preliminary Data

Casing size 5½ Weight 14# Set at 2557 Cemented Yes
Tubing size 2″ Perforations at 2715′ Packer at —
Formation Dundee Lime Pay 2567 to 2715 (Streaks)
T.D. 2724 P.B. No Shot No
Amt. cleaned out — Theo. vol. of well 57 bbls. Bleeding 560
Date brought in 9-7-1938.
I. P. Oil 10 bbls. per day Water — Gas —
P. P. Oil " " " " Water — Gas —
Source of water — Nearness to water —
Water in well None Previous treatments — (dated)
Howco No. — Materials used Time treating
Max. pressures encountered
Results
Application of present treatment — fill hole and treat thru tubing.

Since it is necessary in work of this nature to depend largely on indicated conditions in a well, and there being natural uncertainties as to measurements and variations in the formations to be treated, it is expressly agreed:

(a) That Halliburton Oil Well Cementing Company makes no guarantee of the effectiveness of the materials to be used in the treatment of the well, nor of the results of the treatment.

(b) That it shall not be liable for any injury or damage to the well growing out of or resulting from the treatment of said well, or from the use of said equipment in doing said work.

(c) That Halliburton Oil Well Cementing Company only agrees to furnish the materials herein ordered and its equipment suitable for placing said materials in said well and two operators to assist in performing the work under the supervision of the owner of the well or his representative.

Weber Oil Co.
By W. L. Steelman

HALLIBURTON OIL WELL CEMENTING COMPANY
ACIDIZING TICKET

No. 8196 AT

Charge to Weber Oil Co. Date 9-10-1938
Mail Address Bay City Bank Bldg., Bay City, Michigan
Lease Crawford Well 5 Sec. 28 Twp. 22 N. R 2 E. State Michigan
County or Pool Ogemaw Arrival 10:00 A.M. Howco Trucks No. 614
Trailers No. 57 Hired Transport Trucks — Firm Name —
Gallonage hired trucks — Miles to well 86
Oil used filling well 41 bbls. Water removed before treatment none
How many pumps used One. Time acid on bottom 12.25 P.M.

Pressure Records

Time	Vol. Acid In	Pressure Casing	Pressure Tubing
12:20 P.M.	Start	0	0
12:30 P.M.	600 gal.	700	350
1:10 P.M.	1000 "	800	475
1:55 P.M.	1500 "	700	375
2:45 P.M.	2000 "	700	375
3:30 P.M.	15 bbls. oil	700	700

Flushing oil used 15 bbls. pressure at end: Casing 700#
Tubing 700#
Materials used 2000 gal. (Klersol) acid & 10 gal. blanket
Charges: Acid $350.00 Blanket $ — Total $350.00

The above job was done under the supervision of the owner, operator or his agent whose signature appears below:

Treater (Signed) W. L. Steelman
Carl A. Nicholas
Helper District
Noel M. Campbell Mt. Pleasant, Michigan

The following information is urgently requested in order that we may be fully advised and to enable us to keep our standard of service up to the highest point:

Was the work of Acidizing Equipment satisfactory? Yes
Was the work of Acidizing Crew performed in a satisfactory manner? Yes.
Was the Acidizing job satisfactorily completed? Yes

W. L. Steelman
Owner of Well or Agent

HALLIBURTON OIL WELL CEMENTING COMPANY
Acidizing Order and Data

Date 4-24-1939

Owner Petroleum Investors Inc.
Name of well Knight Invoicing Address
Sec. 16 Twp. 18 N Range 1 E

We authorize you to furnish 1500 gal. Pen. gal. acid, other necessary materials equipment and to assist us in placing same in above well on 4-24-1939 (date) at 2:00 P.M. (time).

Preliminary Data

Casing size 5½ O.D. Weight 17# Set at 3569 Cemented Yes
Liner size — Length — Set at — Cemented —
Tubing size 2" up Jet Perforations at 3624 Packer at —
Formation Dundee Pay Lime

Plaintiff's Exhibit 351

T.D. 3628 P. B. — Shot —
Amt. cleaned out — Theo. vol. of well 78 bbl. Bleeding 605
Date brought in 2-15-1939
I.P. Oil 16 bbls. Water No Gas —
P.P. oil 7 bbls. Water 23 bbl. Gas —
Source of water Bottom Hole Nearness to water 2 ft.
Water in well — Previous treatments (date)
Howco No. Materials used Time treating
Max. pressures encountered
Results
Application of present treatment

Since it is necessary in work of this nature to depend largely on indicated conditions in a well, and there being natural uncertainties as to measurements and variations in the formations to be treated, it is expressly agreed:

(a) That Halliburton Oil Well Cementing Company makes no guarantee of the effectiveness of the materials to be used in the treatment of the well, nor of the results of the treatment.

(b) That it shall not be liable for any injury or damage to the well growing out of or resulting from the treatment of said well, or from the use of said equipment in doing said work.

(c) That Halliburton Oil Well Cementing Company only agrees to furnish the materials herein ordered and its equipment suitable for placing said materials in said well and two operators to assist in performing the work under the supervision of the owner of the well or his representative.

Name of Company Ordering Materials and Equipment

....

(Signed) William Brown

Plaintiff's Exhibit 351

HALLIBURTON OIL WELL CEMENTING COMPANY
Acidizing Ticket

No. 8352 AT

Charge to Petroleum Investors Inc. Date 4-24-1939
Mail Address Mt. Pleasant, Mich.
Lease Knight Well 2 Sec. 16 Twp. 18 N R. 1E State Mich.
County or Pool — Arrival 2:00 P.M. Howco Trucks No. 669-473
Trailers No. 36 — 57 Hired Transport Trucks — Firm Name —
Gallonage Hired Trucks — Miles to Well 55 Miles
Oil used filling well 85 bbls. Water removed before treatment —
How many pumps used One Time acid on bottom 5:12 P.M.

Pressure Records

Time	Vol. Acid in	Pressure Casing	Pressure Tubing
Start 5:00 P.M.		30V	30V
5:05 P.M.	500 gal.	30V	30V
5:10 P.M.	1000 gal.	30V	30V
5:15 P.M.	1500 gal.	30V	30V
5:30	16 bbl.	30V	30V

L. G. King

Flushing Oil used 588 gal. pressure at end. Casing 30 V. Tubing 30 V.
Materials used 1500 Gal. Penn
Charges: Acid $270.00 Blanket 3 gal. Total $270.00

The above job was done under the supervision of the owner, operator or his agent whose signature appears below:

Treater
L. G. King
Helper
D. J. Sargent

Owner of Well or Agent
William F. Brown
District
Eastern Mich.

Plaintiff's Exhibit 351

The following information is urgently requested in order that we may be fully advised and to enable us to keep our standard of service up to the highest point:

Was the work of Acidizing Equipment satisfactory?

Was the work of Acidizing Crew performed in a satisfactory manner?

Was the Acidizing job satisfactorily completed?

Suggestions:

Petroleum Inv. Inc.
William F. Brown
Owner of Well or Agent

PLAINTIFF'S EXHIBIT 354

DOWELL ADVERTISING
FOR THE YEAR, 1932

Date	Vendor	Invoice	Amount	Tot
Sept. 1	Mich. Oil Journal	August Ads	$18.00*	$ 18
Oct. 1	Mich. Oil Journal	September Ads	24.00*	24.
	November			
	Mich. Oil Journal	October Ads	$18.00*	
Nov. 10	The Fred M. Randall Co.	36889	456.55*	
" 10	" " " " "	36891	6.98*	
" 25	" " " " "	36922	684.25	
" 30	" " " " "	37005	841.80	
" 30	" " " " "	37038	11.50	
" 30	" " " " "	37010	78.78	
" 30	" " " " "	37011	116.73	
" 30	" " " " "	37053	43.89	
" 30	" " " " "	37013	32.82	
" 29	" " " " "	36968	99.56	
" 29	" " " " "	36969	43.82	$2,434.
	December			
Dec. 1	Mich. Oil Journal	November Ads	24.00	
" 31	The Fred M. Randall Co.	37330	380.00	
" 31	" " " " "	37336	300.00	
" 31	" " " " "	37349	21.94	
" 31	" " " " "	37353	27.60	
" 23	" " " " "	37210	15.32	
" 23	" " " " "	37211	21.28	$ 790.
	*Paid by The Dow Chemical Company		$523.53	
	Paid by Dowell Incorporated		2,743.29	$3,266.

Plaintiff's Exhibit 354

DOWELL INCORPORATED
ADVERTISING

1933

January	$ 88.11
February	853.64
March	201.64
April	1,266.72
May	276.14
June	10.08
July	243.54
August	205.63
September	357.11
October	286.69
November	368.67
December	385.12
	$4,543.09

1934

January	
February	$ 27.50
March	10.50
April	112.76
May	1,609.13
June.	677.04
July	327.65
August	478.16
September	441.40
October	378.52
November	1,059.55
December	3,321.87
	$8,444.08

PLAINTIFF'S EXHIBIT 355

Failure Time of ½ Gallon Black Iron Drums Containing 15% Sulfuric Acid Solution with a Metal Salt or a Metal Salt and an Acid Regulator

No. on Graph	Drum Number	Acid Solution	Metal Salt	Acid Regulator	Failure Time (Hours) Actual	Failure Time (Hours) Average
1	1/2—136	30.6% Ortho-	—	—	47	
	1/2—137	Phosphoric Acid	—	—	73.5	
	1/2—92	"	—	—	75	
	1/2—91	"	—	—	150	
	1/2—94	"	—	—	246.5	
	1/2—89	"	—	—	292.5	
	1/2—93	"	—	—	510.5	
	1/2—90	"	—	—	696	261.4
2	1/2—179	Hydrochloric Acid Bone Oil Extract			998.7	
	1/2—178	"			1152.8	
	1/2—177	"			1317.5	
	1/2—176	"			1336.3	1201.3
3	1/2—37	93.19% Sulfuric Acid	—	—	2796	
	1/2—36	"	—	—	3027	
	1/2—38	"	—	—	3027	2950
4	1/2—154	15% Sulfuric Acid	0.1% Cadmium Sulfate	0.1% Methanol	18	
	1/2—155	"	"	"	18	18
5	1/2—221	"	0.5% Copper Sulfate	0.1% n-Butanol	17	
	1/2—220	"	"	"	25.5	21.3
6	1/2—152	"	0.1% Cadmium Sulfate	—	26	
	1/2—153	"	"	—	44.5	35.3
7	1/2—150	"	1.0% Cadmium Sulfate	0.1% Dimethyl Amine	42.5	
	1/2—151	"	"	"	42.5	42.5
8	1/2—148	"	1.0% Cadmium Sulfate	—	42.5	
	1/2—149	"	"	—	42.5	42.5
9	1/2—49	"	—	—	21.5	
	1/2—147	"	—	—	22.5	
	1/2—53	"	—	—	33.1	
	1/2—50	"	—	—	36.4	
	1/2—54	"	—	—	40.0	
	1/2—146	"	—	—	56	
	1/2—81	"	—	—	130	
	1/2—52	"	—	—	242.1	
	1/2—51	"	—	—	242.3	
	1/2—82	"	—	—	243	106.1
10	1/2—65	"	0.0043% Arsenous Oxide	0.0057% Gelatine	97.5	
	1/2—66	"	"	Distillate	207.5	152 5
11	1/2—88	"	0.1% Bismuth Oxide	0.1% Rosin	114.5	
	1/2—87	"	"	"	279.5	197
12	1/2—86	"	0.1% Nickel Sulfate	0.1% Glycerine	193	
	1/2—85	"	"	"	210	201.5
13	1/2—84	"	0.5% Copper Sulfate	—	196.5	
	1/2—83	"	"	—	329.5	263
14	1/2—183	"	0.167% Arsenous Oxide	0.1% Sulfuric Acid	234.6	
	1/2—182	"	"	Bone Oil Extract	306.6	270.6

PLAINTIFF'S EXHIBIT 356

10 Gallon Drum Corrosion Tests with Raw 20°Be' Hydrochloric Acid

No Metal Added. Nc Acid Regulator Added

No. on Graph	Drum Number	Hours Until Failure	Maximum Pressure Lbs./Sq. in.	Type of Failure	Time-Pressure Graph Number	Photograph Number	Average Failure Time Hours
3	10-68	0.75	38	Leak in bottom seam	C-1545A	—	1.75
	10-73	1.0	60	Head blew out	C-1550A	76729	
	10-16	1.1	25	Leak at bung	—	—	
	10-14	1.33	38	Leak at bung	—	—	
	10-17	1.8	20	Leak at bung	—	—	
	10-15	2.67	25	Head blew out	C-1505A	76399	
	10-7	3.6	—	Head blew out	—	76402	

Plaintiff's Exhibit 356

10 Gallon Drum Corrosion Tests with 20° Be' Hydrochloric Acid + Metals and Acid Regulators

No. on Graph	Drum Number	Metal	Acid Regulator	Hours Until Failure	Maximum Pressure Lbs./Sq. in.	Type of Failure	Time-Pressure Graph Number	Photograph Number
6	10-65	0.21% Cobalt	0.5% n-Butanol	2.0	62	Leak in bottom seam	C-1542A	—
5	10-64	0.23% Cobalt	"	2.0	66	Leak in bottom seam	C-1541A	—
14	(10-92	1.05% Tin	0.3% Gelatine	5.2) 5.35	52	Head blew out	C-1596A	76924
	(10-91	"	"	5.5)	57	Leak in bottom seam	C-1595A	76923
18	10-78	0.22% Nickel	0.1% HCl Bone Oil Extract	11.6	55	Leak in bottom seam	C-1553A	—
19	10-79	0.24% Tin	"	12	53	Leak in bottom seam	C-1554A	—
20	10-77	0.16% Cobalt	"	16	57	Leak in bottom seam	C-1552A	—
21	10-83	0.21% Tin	"	17.4	64	Head blew out	C-1558A	76731
23	10-84	0.24% Tin	0.5% "	24.6	55	Leak in bottom seam	C-1559A	—
24	10-85	0.27% Cobalt	0.1% "	25.5	60	Head blew out	C-1560A	76732
25	10-90	1.14% Tin	(2.5% Vol. Monoethyl Amine (22.5% Vol. Diethyl Amine	29.75	63	Leak in bottom seam	C-1594A	76922
26	10-89	0.48% Tin	0.5% HCl Bone Oil Extract	32.3	55	Leak in bottom seam	C-1593A	76921
27	10-76	0.20% Cobalt	"	32.4	56	Leak in bottom seam	C-1551A	—
32	10-63	0.26% Arsenic	0.0057% Gelatine Distillate	563.2	54	Blew out	C-1604A	—
33	10-62	0.30% Arsenic	"	667.4	46	Leak in bottom seam	C-1603A	—
31*	(10-108	1.32% Arsenous Oxide	25% Vol. Barrett Comm. Pyridine No. 2	Not Completed:		Started 7-2-41, 9:45 p.m.		
	(10-109	"	"			Started 7-2-41, 10:35 p.m.		

* Corresponds to Composition B of the patent.

10-Gallon Drum Corrosion Tests with 30% Ortho-Phosphoric Acid Solution With or Without a Metal and/or an Acid Regulator

No. on Graph	Drum Number	Metal	Acid Regulator	Hours Until Failure	Maximum Pressure Lbs./Sq. in.	Type of Failure	Time-Pressure Graph Number	Photograph Number	Average Failure Time Hours
1	10-71	—	—	21.75	47.2	Leak in bottom seam	C-1548A	—	35.4
	10-40	—	—	22.7	41	"	C-1525A	—	
	10-72	—	—	25	50	"	C-1549A	—	
	10-38	—	—	27.5	41	"	C-1523A	—	
	10-34	—	—	38.7	39	Leak	C-1519A	—	
	10-33	—	—	39.8	45	"	C-1518A	—	
	10-37	—	—	40.1	40	Leak in bottom seam	C-1522A	—	
	10-39	—	—	40.8	32	"	C-1524A	—	
	10-35	—	—	42.6	35	Leak	C-1520A	—	
	10-36	—	—	55.3	30	Leak	C-1521A	—	
2	10-50	0.52% Nickel	—	20.75	56	Leak in bottom seam	C-1533A	76694	20.75
3	10-49	0.51% Nickel	—	22.1	51.5	Leak in bottom seam	C-1532A	76693	22.1
4	10-29	0.145% Copper	—	23.9	35	Bottom blew out	C-1514A	76489	27.3
	10-30	0.145% Copper	—	30.75	32	Leak in bottom seam	C-1515A	—	
5	10-31	0.160% Nickel	—	33.1	55	Leak in bottom seam	C-1516A	76493	33.1
6	10-32	0.175% Nickel	—	57.9	53	Leak in bottom seam	C-1517A	—	57.9
7	10-104	0.102% Arsenic	0.053% Pyridine Base Mix. (Interlake)	233.5	17.5	Leak in bottom seam	C-1641A	—	259.6
	10-103	"	"	285.8	14.5	"	C-1642A	—	
8	10-52	0.19% Arsenic	—	948	9.0	Leak in bottom seam	C-1602A	—	793.9
	10-51	"	—	639.8	14.5	Bottom blew out	C-1601A	—	

Note: This table does not include arsenic treated drums.

PLAINTIFF'S EXHIBIT 356

FAILURE TIME OF ICC 5A 10-GALLON DRUMS CONTAINING 20°Be' HYDROCHLORIC ACID SOLUTION AND A METAL OR A METAL AND AN ACID REGULATOR

No. on Graph	Acid Solution	Metal	Acid Regulator	Failure Time Hours
1	30% Ortho-Phosphoric Acid	—	—	35.4 (Average of 10)
2	95.5% Sulfuric Acid	—	—	Tests not Completed Started 9:00 a.m. 9:30 a.m. 4-30-41
3	20°Be' Hydrochloric Acid	—	—	1.75 (Average of 7)
4	"	—	0.5% n-Butanol	1.0
5	"	0.23% Cobalt	"	2.0
6	"	0.21% Cobalt	"	2.0
7	"	0.23% Mercury	—	2.0
8	"	0.19% Mercury	—	2.4
9	"	0.13% Nickel	—	3.1
10	"	0.306% Bismuth	—	4.8
11	"	0.125% Nickel	—	5.25
12	"	0.118% Nickel	—	5.3
13	"	0.315% Bismuth	—	5.3
14	"	1.05% Tin	0.3% Gelatine	5.35 (Average of 2)
15	"	0.330% Bismuth	—	7.75
16	"	0.303% Bismuth	—	8.0
17	"	0.115% Nickel	—	9.5
18	"	0.22% Nickel	0.1% Hydrochloric Acid Bone Oil Extract	11.6
19	"	0.24% Tin	"	12.0
20	"	0.16% Cobalt	"	16.0
21	"	0.21% Tin	"	17.4
22	"	—	"	20.2 (Average of 2)
23	"	0.24% Tin	0.5% Hydrochloric Acid Bone Oil Extract	24.6
24	"	0.27% Cobalt	0.1% Hydrochloric Acid Bone Oil Extract	25.5
25	"	1.14% Tin	2.5% Volume Monoethyl Amine 22.5% Volume Diethyl Amine	29.75
26	"	0.48% Tin	0.5% Hydrochloric Acid Bone Oil Extract	32.3
27	"	0.20% Cobalt	"	32.4

			Bone Oil Extract	11.6
19	"	0.24% Tin	"	12.0
20	"	0.16% Cobalt	"	16.0
21	"	0.21% Tin	"	17.4
22	"	—	"	20.2 (Average of 2)
23	"	0.24% Tin	0.5% Hydrochloric Acid Bone Oil Extract	24.6
24	"	0.27% Cobalt	0.1% Hydrochloric Acid Bone Oil Extract	25.5
25	"	1.14% Tin	2.5% Volume Monoethyl Amine 22.5% Volume Diethyl Amine	29.75
26	"	0.48% Tin	0.5% Hydrochloric Acid Bone Oil Extract	32.3
27	"	0.20% Cobalt	"	32.4
28	"	—	"	37.57 (Average of 2)
29	"	0.229% Antimony	—	47.25
30	"	0.269% Antimony	—	59.5
31[x]	"	1.32% Arsenous Oxide	25% Volume Barrett Commercial Pyridine No. 2	Tests not Completed Started 9:45 p.m. 10:35 p.m. 7-2-41
32	"	0.26% Arsenic	0.0057% Gelatine Distillate	563.2 hrs.
33	"	0.30% Arsenic	0.0057% Gelatine Distillate	667.4

[x]Corresponds to Composition B of the patent.

PLAINTIFF'S EXHIBIT 356

Failure Time of ICC 5E and ICC 5A 55-Gallon Drums Containing Hydrochloric Acid Solution With or Without a Metal or an Acid Regulator

No. on Graph	Drum No.	Acid Solution	Metal Salt	Acid Regulator	Failure Time Hours	Maximum Pressure
			ICC 5E Drum Tests			
1	1	22.5% Hydrochloric Acid Solution	—	—	20	17
2	2	25 % "	0.159% Arsenous Oxide	—	59.5	16
3	6	24.9% "	—	0.4% Pyridine Bases[x]	132.5	23
4	3	25 % "	0.185% Arsenous Oxide	"	255.5	18.5
5	4	25 % "	0.753% Arsenous Oxide	1.0% Gelatine	471.5	14
			ICC 5A Drum Tests			
1	13	25.2% "	0.19% Arsenous Oxide	—	44.5	24
2	14	23.5% "	—	—	165.5	73
3	10	22.3% "	—	0.4% Pyridine Bases[x]	429	8–¼
4	9	23.3% "	0.765% Arsenous Oxide	1.0% Gelatine	479	31
5	11	22.2% "	0.217% Arsenous Oxide	0.4% Pyridine Bases[x]	573	30

[x]Barrett Pickling Compound No. 93

PLAINTIFF'S EXHIBIT 357

ANALYSIS OF ACID SOLUTIONS OF TESTS No. 3 and 7

	Test No. 3		Test No. 7	
	Atmospheric Pressure 43°C. (110°F.)		Atmospheric Pressure 30°C. (86°F.)	
Hours from Start	% Hydrochloric Acid	% Fe	% Hydrochloric Acid	% Fe
0	15.0	0.0	15.0	0.0
3	10.83	2.91	13.6	1.41
6	8.63	4.37	12.6	1.96
9	6.89	5.59	11.6	2.73
12	4.95	6.91	10.3	3.45
15	3.15	8.13	9.5	3.97
18	1.86	9.03	8.2	4.66
21	0.47	10.05	7.4	5.14
24	0.012	10.29	6.1	5.99

SUMMARY OF TESTS

Test No.	1	3	8	7
Time of Test	21.75 hours	24 hours	24 hours	24 hours
Temperature Maintained	43°C.	43°C.	30°C.	30°C.
Maximum	48°C.	46°C.	33°C.	33°C.
Minimum	40°C.	40°C.	28°C.	28°C.
Pressure Maintained, Lbs./sq. in.	1000	Atmospheric	1000	Atmospheric
Maximum	1080	—	1060	—
Minimum	980	—	960	—
Analysis of Solution After Test				
% Hydrochloric Acid	0.014	0.012	4.6	6.1
% Iron	10.62	10.29	7.04	5.99
Samples Taken	At end of run.	Every 3 hrs.	At end of run.	Every 3 hours.

PLAINTIFF'S EXHIBIT 358

Summary of acid corrosion tests of 15.1% commercial hydrochloric acids using metal strips of strap iron

Commercial Hydrochloric Acid	% Reduction in Corrosiveness Strap iron Series N	Strap iron Series O	Average
American Cyanamid and Chemical Corp.	1	....	1
Bay Chemical Co., Inc.	—14	—17	—15.5
Central Chemical Sample 1	5	....	5
Central Chemical Sample 2	4	....	4
Consolidated Chemical Industries, Inc., Fort Worth, Texas	11	....	11
Consolidated Chemical Industries, Inc., Houston, Texas	0	....	0
Detroit Chemical Works	3	....	3
Dow Chemical Co., San Francisco, Calif.	—8	—1	—4.5
Dow Chemical Co., Sample 1	....	4	4
Dow Chemical Co.. Sample 2	....	8	8
General Chemical Co.	3	....	3
Hooker Electrochemical Co.	0.8	....	0.8
Monsanto Chemical Co., Sample 1	6	....	6
Monsanto Chemical Co., Sample 2	0.5	....	0.5
Ozark Chemical Co.	—12	—4	—8
Pennsylvania Salt Mfg. Co.	2	....	2
Southern Acid & Sulphur Co., Inc.	—12	—5	—8.5
Stauffer Chemical Co., Sample 1	3	....	3
Stauffer Chemical Co., Sample 2	8	....	8

The average reduction in corrosiveness of the above 19 acid samples is 1.2%.

The average reduction in corrosiveness of the acids from the 13 different companies is —0.1%.

PLAINTIFF'S EXHIBIT 360

Dowell Incorporated

ADVERTISING

Year	Amount	Number Paid Treatments Using Grebe-Sanford Method
1932*	$ 3,266.82	236
1933	4,543.09	1,119
1934	8,444.08	1,984
1935	19,371.05	2,123
1936	16,784.67	2,994
1937	22,871.06	4,666
1938	35,358.59	3,674
1939	35,897.22	3,980
1940	53,324.98	5,035

*Figures are for Dow and Dowell

PLAINTIFF'S EXHIBIT 362

Physical Laboratory
THE DOW CHEMICAL COMPANY

File No. 0109

From J. J. Grebe. By N. Poffenberger.

Date Rec'd, Aug. 18, 1930. Date Finished, Sept. 26

Acid Treatment of Well 77

Summary:

Materials pumped down well.

Water—before any acid was added to the well ....6680 gallons

Water—pumped down outside the acid hose 3050 gallons

The water pumped with the acid by the acid pump could not be measured.

Total....................9730 gallons

Acid.

1320 gallons or 13,000 pounds of 30% acid or 3,900 pounds of 100% HCl.

Water pressure on well. 12 pounds per square inch, maintained at the constant value by an overflow 25 feet above the well.

Rate of water into the well at the start of the experiment. Gallons per hour..............................25

Rate of water into the well at the end of the experiment, with the acid pump also pumping more water. 15

Rate of water into the well at the end of the experiment, after the acid had been shut off for 24 hours. . 15

Depth of well at the start of the experiment.....1505 ft.

Depth of well Sept. 26, at the end of the experiment ....1490 ft.

Physical Laboratory
THE DOW CHEMICAL COMPANY

File No. 0109

Subject Increasing brine flow from Well 77
By Thompson

Acid Treatment of Well 77 to increase its productivity.
Previous Treatment:
Water — 9730
No. 30% acid — 13,000 lbs.
Wash after acid 2837 gallons

Tank at Well 59" Dia.

Date	Time	Total Time Hours	Hours Off	Meter	Gals. H_2O per H.	Total Gals.	Acid	Amount Add	Total	Lbs. Acid	Press. on Well
9-30	4:00	0		3815			33"				22
10-1	9:30	17.5		3970	8.9	155	27"	72	72		21
10-1	10:30	1.0					26.5	6	78		38
10-1	10:30						41.5				38
10-1	4:00	5.5		4235	48.1	420	40	18	96		40
10-2	11:00	19.0		4728	26.0	913	35	60	156		40
10-2	12:30	1.5					34.5	6	162		40
	12:30						50				
10-2	4:00	3.5		4850	35	1035	48.5	18	180	14,800	40
10-3	10:00	18.0		5274	23.6	1459	43.5	60	240		40 lbs.
10-3	4:00	6		5394	20	1579	42.	18	258		40
10-4	9:30	17.5		5762	21	1947	38	48	306		40
10-4	10:30		½ hr.				37.5	6	312		40
10-4	11:00	1.5		5800	21	1985	52.5				40
10-4	1:00	2		5860	30	2015					40
10-6	11:00	46		6790	20.4	2045	39	162	474		40
[illegible]	12:00	1		[illegible]	20	[illegible]	44		474		40

Plaintiff's Exhibit 362

Date	Time	Total Time Hours	Hours Off	Meter	Gals. H_2O/Hr.	Total Gallons	Acid	Amount Added	Total	Press.
10-6	4:30	4.5		6992	18.5	3043	43	12	486	40
10-7	9:30	17		7210	13	3261	39.5	54	540	40
10-7	3:30	6		7324	19	3375	37.5	24	564	40
10-8	7:30	16		7627	18	3678	32.5	60	624	40
10-8	12:00	4.5					31	18	642	40
10-8	"						36			40
10-8	5:00	5		7813	37	3864	33.5	30	672	40
10-9	10:30	17.5		8127	17	4178	28	66	738	40
10-9	12:00	1.5					27.5	6	744	40
10-9	"						40			40
10-9	3:00	3		8213	28	4264	38	24	768	40
10-10	10:00	19		8568	19.6	4619	31.5	78	846	40
10-10	"						47			40
"	2:00	4		8650	20.5	4701	45	24	870	40
10-11	11:30	20.5		9015	18.4	5066	40	60	930	40
10-13	9:00	47.5		9838	17.8	5889	28.5	138	1068	40
10-13	5:00	8		9988	18.7	6039	26	30	1098	40
10-14	10:00	17		10305	18.4	6356	22	48	1146	40
10-14	5:00	7		10305	!		20.5	30	1176	40

Electricity was off three times during P.M. and meter run backwards. Current was still off at 5 P.M.

Date	Time	Total Time Hours	Hours Off	Meter	Gals. H_2O/Hr.	Total Gallons	Acid	Amount Added	Total	Press.
10-15	9:30	17.5	½	10725	25	6781	17	42	1218	40
10-15	3:30	6		10840	19.1	6896	15	24	1242	40
10-16	9:00	17.5		11160	18.1	7216	11.5	42	1284	40

Date	Specific Gravity	Ph.	Acid
10–22	1.062	1.3	1.8
23	1.113	2.4	0.15
24	1.192	3.5	0.12
27	1.211	4.95	0
28	1.213	4.9	
29	1.219	4.9	
30	1.221	4.9	
31	1.225	5.1	

11– 3—Quinlan to quit bringing in sample.

DESCRIPTION OF THE EXPERIMENT

Work was started at Well 77 on August 18, 1930, when we started installing an acid tank, the hose in the well and the acid pump. It took some time to get an adequate water supply for the experiment. Two points were pounded into the sand at the well, but would not give enough water to keep the pump primed. A nearby discarded flowing well was pumped for 24 hours but the water obtained was too dirty to put down the brine well. Finally a half mile pipe line was run to Well 77 where the drillers had left two good well points in the ground. A special low capacity, high head centrifugal pump was installed there on September 5, and has been entirely satisfactory.

Before adding acid to the well, it was flushed out with 6700 gallons of water. However, about 150 gallons were required to fill up the casing. The average rate at which the water ran into the well under 12 pounds pressure was about 25 gallons per hour. On September 6 we started pumping acid down the well and continued it until Sept. 24, except for two periods of 17 hours when the acid pump went bad, and one period of 24 hours to take out the hose and inspect it. The only trouble encountered was the water meter occasionally sticking ~~to the~~ low rates.

The experiment was stopped on September 24 because the acid and water from the acid pump seemed to back up the water, which normally went down around the outside of the hose, and made the meter connected to it to run backwards. We were afraid the acidified water might reach the casing and attack it if we continued. The hose was pulled from the well, and from its appearance and that of the supporting cable, it was evident that the acid had backed up to about 1300 feet, which is several hundred feet below the bottom of the casing, (1138 feet). The bottom of the well measured with the standard well chain is at 1490 feet, about 15 feet higher than it was originally.

We have pumped 13,000 pounds of 30% acid into the well, approximately 9,000 pounds less than into Well 80 before we attempted to pump it. Our present plan is to continue to pump in water until Sept. 29, then put back the hose and pump in about 15,000 pounds more of acid, then wash it with water. It will then be ready to have its flow tested.

PLAINTIFF'S EXHIBIT 363

Physical Laboratory
THE DOW CHEMICAL COMPANY

File No. 0075
By N.P.

To Acid treatment at Well 80—
Subject: To increase porosity of sand.
Charge No. 223
Date Finished, 8-18-30
Results:

Acid and water or brine was pumped down the well to attack any limestone formation that might be present. Experiment was carried on from July 7 to Aug. 15. In the time 22,000 pounds of 30% HCl solution was pumped down the well.

At the start of the experiment the brine level in well was 108′ from the top. At the end of the time it was 20′, the difference being due to the difference of the densities of brine and water.

Water was pumped down well for one week during the time the rate fell from 0.4 gal. per minute to 0.1 gal. per minute.

The rest of the time brine was used to keep the acid going down the well. The well took brine at a rate of 0.5 to 0.3 gal. per min.

Description of Work:

The brine level in well was measured by conductivity cell on end of wire and was 108′ from top of well. This made a head of only $108 \times \frac{1}{2.3 \times 1.25} = 38\#$ pressure for putting down brine or 30# for putting down water. On August 16 when the work was stopped the level was 20′ from the top, and on Aug. 15 it was 26′ from the top.

PLAINTIFF'S EXHIBIT 364

Physical Laboratory
THE DOW CHEMICAL COMPANY

To J. J. Grebe By N. Poffenberger File No. 9221
Subject: Dissolving Scale in Tubes with Acid using some Arsenic Compounds to Prevent Corrosion of the Iron Tubes.
Charge No. 1802
Date Rec'd, 10-31-29
Date Finished, 7-21-30

Samples of silicate scale were obtained from Nelson Griswold at the Power Plant. He claimed they were not affected by concentrated HCl and concentrated HNO_3, so no work was done on the scale.

The use of arsenic compounds to inhibit hydrochloric acid corrosion was checked by laboratory corrosion tests, using acid up to 6 N. (20% HCl).

Strips of sheet iron, about 6″ long and ¾″ wide, weighing about 10 grams were used in the work. They were placed in 500 c.c. of acid and allowed to stand 24 hours before they were removed, brushed and weighed.

Sodium arsenate and sodium arsenite are both effective in retarding corrosive action of HCl at room temperatures. In general the arsenate is the more effective except at the highest concentration used—10 grams per 500 cc. However they do not prevent corrosion.

The table given below shows the effect of both change of acidity and changes in the amount of arsenic compound.

Loss in Weight in 24 Hours Expressed as Percentages

500 cc. acid — 2 grams of arsenic salt

Normality	Percent Loss wt. of iron— no arsenic	Per- cent with Sodium Arsenate	Per- cent with Sodium Arsenite
1	6.7	0.3	0.2
4	28.8	0.3	1.2
6	100.0	1.7	5.5

Loss in Weight in 24 Hours Expressed as Percentages

500 cc. = 6 N. HCl — amount of salt varied

Grams salt per 500 cc.	Percent Loss weight No arsenic	Percent with Sod. Arsenate	Percent with Sod. Arsenite
0	100		
2		1.7	5.5
4		1.4	2.2
6		1.3	1.7
8		1.1	1.2
10		1.4	.7

PLAINTIFF'S EXHIBIT 366

Case 172

Richard H. Carr and Howard C. Humphrey

Method for Increasing Fluid Production from Oil Wells.

This invention relates to an improved method for facilitating and increasing the flow of oil or gas wells, especially wells producing from sand formations, and it is an object of the invention to treat such producing sand formations with suitable chemical reagents possessing the ability to react with such formations to partially discharge or disintegrate the same or increase the porosity thereof in order to render the sand formation around the well bore permeable to the flow of the desired fluid into such a bore. It often occurs that the fluid producing area of a well is disposed in what is referred to as "hard" sand which restricts the passage of the desired fluid (oil or gas) into the well bore and the present invention provides for the chemical treatment of such sand, and also other sand formations to render the same more permeable to the passage of fluid and the consequent delivery of such fluid to a well bore.

In certain sand formations of producing wells, the sand particles are united by a cementitious binder which closely unites the sand grains or particles and decreases the porosity of the formation to the end of greatly restricting the desired inflow of fluid into the well bore, and it is another object of the present invention to provide selected chemical reagents which possess the ability to attack and dissolve the cementitious binder uniting the sand particles, whereby to disintegrate or dissolve the binder, thereby increasing the porosity of the sand formation and providing for increased fluid flow.

It is another object of the invention to introduce an acid reagent into the oil or gas producing formation serving a well under pressure so that the pore space of the sand in the area penetrated by the reagent will be enlarged or increased to reduce the restriction to flow of the desired fluid into said well. It has been proposed heretofore to in-

crease oil well production by applying hydrochloric or muriatic acid to the producing formation of a well disposed in limestone, whereby to permit such an acid to attack the lime rock to increase its porosity. The present invention, however, deals with the problem of securing increased porosity and fluid flow in wells producing from sand formations which provide greater difficulties than exist in the treatment of limestone. Such sand formations comprise dense compact grains often united by a more or less cementitious binder composed of a mixture of materials consisting usually of clays, calcium, metallic oxides and other substances. The restricted pore spaces of these materials are often such as to greatly hamper or limit the passage of oil or gas into the well bore, and to enlarge such pore spaces to admit of freer fluid passage therethrough has been a long standing problem on the part of oil well operators. Explosives have been used in such capacities with but a small degree of success, owing to their limited range of influence in the formation. Explosives also involve expensive cleaning and the possibility of loss of production as well as other objectionable features. Since lime does not predominate in sand formations, the use of hydrochloric acid alone is not effectual or sufficient in most sands for the purpose of increasing such porosity, and while the use of the chemical disintegration method would be preferable over explosives by reason of its safety, assurance and economy, yet the industry has and is at present using explosives in efforts to attain increased production from sand producing regions.

We have discovered that the cementing materials restricting the flow of fluids in producing sands of a well can be successfully disintegrated to cause augmented oil or gas flow into the well, this being attained by the use and manner of application of certain selected chemical reagents as hereinafter more fully described.

In carrying out our process, a mixture of hydrochloric and nitric acids is introduced into the well bore and the producing sands through the usual tubing. By advancing

these acid reagents through the producing sands under pressure, the pore space of the area treated thereby around the well bore will be enlarged and the benefits of the process obtained by rendering the sand more permeable to the passage of the desired fluids. We have, also, found it necessary to use hydrofluoric acid in the treatment of certain sands when hydrochloric and nitric acids are relatively ineffectual.

Additional features of our process involve: the preliminary treatment of the producing sands, prior to the addition of the acid reagents, with carbon tetrachloride or other solvent, whereby to dissolve paraffinic, asphaltic or other coatings from the sands adjacent to the cavity, thus rendering the same suitable for immediate reaction with the acid reagents; again, we treat the surfaces of the tubing or other metallic parts of the well bore equipment with a coating to prevent the acid reagents from appreciably attacking and injuring such metal parts with which the agents come into contact; for instance, the interior of the tubing may be coated with cellulose, nitrate or other acid resisting varnish when hydrochloric or nitric acids are used, or in the case of the use of hydrofluoric acid we preferably line the tubing with a coating of solidified paraffin wax to render it resistant to acid attack.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawing, in which one embodiment of our invention has been set forth. In said drawing: Figure 1 is a diagrammatic view in vertical section of an oil well disclosing an arrangement admitting of the use of our process thereon; Figures 2 and 3 are detailed microscopic views disclosing the appearance of the producing sand when magnified before and after treatment thereof in accordance with the invention.

Referring more particularly to the drawing, the numeral 1 designates the casing of an oil well. The casinghead is indicated at 2, 3 is a control valve therefor, 4 indicates the tubing extending downward through the casing

and space therefrom to produce an annular chamber 5 between the adjacent walls of the tubing and the casing. The bottom of the casing is provided with the usual strainer 6 which is disposed in the liquid producing sand 7 in the bottom of the well bore.

In order to attack these sands to increase porosity and permeability and reduce fluid flow restricting substances, the well is first filled with a liquid possessing a lower specific gravity than the acid reagents, oil being particularly suitable and economical for this purpose. In the filling of the well, the oil may be introduced either through the casing or the tubing. In either of them both the casing and the tubing are first filled with liquid in such a manner as to eliminate free gas in the well bore and render it hydrostatically controllable.

Following this operation a desired amount of the acid reagent is introduced into the tubing. If a mixture of hydrochloric and nitric acids is used, the said acids may be retained in a container 8 which is provided with valved outlet line 10 leading to the inlet side of a pump 11. The outlet side of said pump is connected by means of a line 12 provided with a control valve 13 with the upper end of the tubing 4. As soon as a desired amount of the acids has been so introduced into the tubing, the outlet valve 3 of the casinghead is closed, and since the well is full of oil, the acids, being heavier than the oil, settle to the bottom of the well with the oil above the same, the escape of the oil through the space 5 being prevented by the closing of the casinghead outlet. The acid is then displaced from the tubing by pumping an additional quantity of oil into the tubing. This oil may be obtained from any suitable source 9 and is preferably advanced by the pump 11 to place the desired pressures on the acid reagents, forcing the latter into the producing sands of the well bore and insuring complete displacement of said reagents from the tubing into the producing formation. As soon as the reagents have been forced into the producing sands, the control valve at the top of the tubing may be closed and the well left stand-

ing for a sufficient period of time to permit complete reaction of the reagents with the producing sands.

As previously stated, it may be preferable before introducing the acids into the sands to treat the latter and the lower part of the well bore with a solvent, such as carbon tetrachloride. This solvent dissolves paraffinic and asphaltic coatings of a hardened or solidified nature so that the acid will be able to reach directly the materials to be dissolved. Also, the tubing, casing, or other metallic parts which come into contact with the acid reagents may be treated with acid resisting coatings. In this connection the said parts may be covered with an acid resisting varnish, such as cellulose nitrate, or may be covered with paraffin. In this manner the use of the acid is rendered practicable and will not injure the more costly metallic equipment.

We do not limit ourselves to the specific reagents above set forth nor to any particular quantity or percentage thereof. The acid reagents recited are of ordinary commercial strength and their quantity will vary with the character of the producing formation. In certain wells which we have treated in accordance with our process, we have substantially filled the tubing with the acid reagent before pumping in added oil to displace the reagent from the tubing into the producing formation. Obviously, however, this amount may be varied by increasing or decreasing the same as circumstances may require. After the reagent has been allowed to react with the producing formation for the desired period of time, the well may be swabbed or pumped to remove the fluids or solids suspended therein and the operation of the well resumed.

The condition of some depleted oil or gas producing areas is such that the rock pressures have been reduced by withdrawals of oil and gas to such an extent that undesirable quantities of oil would penetrate and pass into the producing formation before it would be possible to establish a column of fluid to the top of the bore hole. In such cases, to admit of the use of the acid reagents previously described under such conditions, the said acid reagents

would be introduced into the producing formation by delivering it without the loading of a column of oil, or under a height of oil fluid in the bore hole which would be commensurate with the rock pressure of the area and suitable to conditions.

What is claimed is:

1. The method of increasing the flow of wells producing a desired fluid from sand formations, which consists in introducing into the well a chemical reagent possessing the ability to react with the producing formation to increase the pore space therein in communication with a well bore, whereby to reduce the restriction originally offered by the formation to the inflow of the desired fluid into the well bore.

2. The method of increasing the flow of wells producing a desired fluid from sand formations, which consists in introducing into the well an acid reagent possessing the ability to react with the producing formation to increase the pore space therein in communication with a well bore, whereby to reduce the restriction originally offered by the formation to the inflow of the desired fluid into the well bore.

3. The method of increasing the flow of wells producing a desired fluid from sand formations, which consists in introducing into the well under pressure a chemical reagent possessing the ability to react with the producing formation to increase the pore space therein in communication with a well bore, whereby to reduce the restriction originally offered by the formation to the inflow of the desired fluid into the well bore.

4. The method of increasing the flow of wells producing a desired fluid from sand formations, which consists in introducing into the well under pressue an acid reagent possessing the ability to react with the producing formation to increase the pore space therein in communication with a well bore, whereby to reduce the restriction originally offered by the formation to the inflow of the desired fluid into the well bore.

5. The method of increasing the flow of wells producing from sand formations, which consists in introducing into the well a chemical reagent which attacks the binding materials formed between the sand particles, whereby to effect the dissolution of such binding materials, and in subsequently removing the dissolved binding materials from the well.

6. The method of increasing the flow of wells producing from sand formations, which consists in introducing a mixture of hydrochloric and nitric acid into such producing sands to effect the dissolution of the binding materials uniting the sand grains, whereby to leave the sand formation adjacent to the producing region of the well bore in a state admitting of the free passage of the desired fluid therethrough.

7. The method of increasing the flow of wells producing from sand formations, which comprises introducing into such sand formations through the tubing of the well a chemical reagent in the form of a mixture of hydrochloric and nitric acid, and applying pressure to said reagent to distribute the latter through a comparatively wide region contiguous the well bore in such producing sands.

8. The method of increasing the flow of wells, which consists in introducing into the producing sands of such a well a chemical reagent comprising a mixture of hydrochloric and nitric acids, and applying pressure to said reagent to distribute the latter through the producing sands of the well supplying fluid to the well.

9. The method for increasing the flow of oil wells producing from sand formations which consists in dissolving the binding materials formed between sand grains by applying a dissolving agent thereto, and removing such materials following their dissolution from the well, whereby to provide interstitial spaces between the sand grains admitting of the relatively free passage of oil.

10. The method of increasing the flow of oil wells producing from sand formations which consists in introducing through the bore of such a well and into contact with the

sand formation thereof a solvent capable of dissolving paraffinic and asphaltic coatings, then introducing into contact with the cleaned sands an acid reagent capable of disintegrating such sand formations sufficiently to admit of relatively free flow of oil therethrough.

11. The method for facilitating the flow of oil into the producing region of a well bore, which consists in providing such a well with the usual casing and tubing, introducing into the well a body of oil by way of the tubing to fill the tubing and the annular space formed between the tubing and the casing with said oil in such manner as to substantially eliminate free gas, introducing into the tubing an acid reagent consisting of a mixture of hydrochloric and nitric acids, and applying pressure to the reagent in said tubing to displace the latter and force the same into contact with the sand formation.

PLAINTIFF'S EXHIBIT 367

Richard H. Carr and Howard C. Humphrey
"Chemical Reagent for Use in Oil Wells"—Case 174.
Filed Oct. 10, 1932—Serial No. 637,099.
Assigned to The Pure Oil Company.

This invention relates to an improved compound or chemical reagent for treating the producing formations of oil or gas wells to facilitate the flow of a desired fluid into the bore of such a well, and it is an outstanding object of the invention to provide an improved reagent which possesses the capability of reacting with such producing for-

mations to partially dissolve or disintegrate the same, or increase the porosity thereof, in order to render such formations around the well bore more permeable to the flow of the desired fluid into the bore and thereby increase the fluid output of a well so treated.

In our prior copending application, Serial No. 620,180, filed June 30, 1932, we have set forth a process for accomplishing the above by the use of a reagent in the form of hydrofluoric and other equivalent acid, which is introduced into the well bore through the customary tubing or casing and advanced, preferably under pressure, into the producing formation of the well, in order that the acid reagent will attack the formation to afford the desired increased flow of fluid over that normally afforded by the formation. We have found in the operation of our process that such an acid reagent, while highly effective in increasing the porosity and fluid output of the producing formation, possesses the disadvantage of attacking the metallic members of an operating well, such as the ordinary tubing and casing, into which the reagent comes into contact, causing their premature impairment together with high replacement costs. To overcome the damaging effects caused by corrosion and of a detrimental character to the tubing and casing, we heretofore coated such metallic parts with a coating of various substances, such as acid resisting varnish, solidified paraffin wax and the like, to such an extent as to resist acid attack. The coating of the metal parts however, adds considerably to the expense of using the process and is not altogether satisfactory in affording complete protection of the metal from acid attack.

We have discovered that improved resistance of the metal in the well bore to the corrosive effects of such reagents may be obtained through the use of a reagent modified in its action by the addition thereto of relatively small quantities of compounds belonging to the nitrogen group, whereby the reagent may be passed harmlessly through metallic members or over metallic surfaces without exerting any material detrimental action thereon. In our afore-

said prior application, we have disclosed the use of an acid reagent consisting of hydrofluoric or hydrochloric acids, or a mixture of hydrochloric and nitric acids. These halogen-containing acids, especially hydrofluoric and hydrochloric acids are quite active in their attack upon sand and limestone producing formations from which hydrocarbon oils and gases emanate, but as is well known, such acids readily combine with certain metals, such as iron, causing the undesired corrosive effects in the metallic members of the well bore, as above described. However, by the addition to such acids of a modifying or inhibiting compound, selected from compounds belonging to the nitrogen group, as hereinafter specified, a neutralizing effect is obtained preventing the acids from detrimentally attacking metallic surfaces but without any substantial impairment of their ability to dissolve or disintegrate and vigorously attack the minerals found in the producing formations. Thus in producing our improved reagent for use in the capacity set forth, we may provide a mixture composed of hydrofluoric, hydrochloric or hydrochloric ~~and nitric~~ acids to which we add a small per cent, varying from approximately .2% to 3.00% of a compound belonging to the nitrogen group including arsenic, antimony or bismuth. Among these compounds, we have found that by adding to the acid approximately ½ of 1 per cent by weight of arsenic acid or arsenious oxide, very practicable results can be obtained. A specific example of our improved treating agent may consist of 99.5% of hydrofluoric acid combined with .5% of arsenic acid or arsenious oxide. The treating agent thus formed may be pumped through pipes, casings, tubes or the like and maintained therein for appropriate periods of time necessary in permitting the reagent to react on the producing formations and yet there will be no appreciable deleterious action on the metals composing such pipe members. Moreover, it is usually unnecessary, as heretofore, to coat the metal members with protective coatings such as paraffin or the like, although such coatings may be used if desired. The methods for using the reagent in treating producing for-

mations constitutes the subject matter of our aforesaid co-pending application and therefore detailed explanation thereof is considered unnecessary herein, inasmuch as the present invention has to do with the compounding of such a reagent suitable for the purposes specified. The amount of the modifying or inhibiting agent used depends upon the depth of the well bore or the length of the metallic members disposed in such a bore and the surface area of the metal to be protected, the inhibitor serving to produce a protective coating or deposit on the surfaces of the metal with which the reagent comes into contact to minimize its corrosive action.

What is claimed is:

1. An acid reagent for treating the producing formations of oil wells to increase fluid production composed of a mixture consisting principally of hydrofluoric acid and a relatively small quantity of an arsenic compound.

2. An acid reagent for treating the producing formations of oil wells to increase fluid production composed of a mixture consisting principally of hydrofluoric acid and approximately one-half per cent by weight of an arsenic compound.

3. An acid reagent for treating the producing formations of oil wells to increase fluid production composed of a mixture consisting principally of hydrofluoric acid and a relatively small quantity of an arsenic compound selected from a group consisting of arsenic acid and arsenious oxide.

4. A non-corrosive acid reagent for treating the producing formations of oil wells composed principally of hydrofluoric acid and a small quantity of a modifying agent in simple admixture with the hydrofluoric acid to neutralize its normal corrosive action on metallic members.

5. A chemical compound for use in increasing the flow of fluid from the producing regions of oil or gas wells, comprising an acid reagent possessing the ability to react with the producing formation of such a well to increase the pore space therein in communication with a well bore, and a modifying agent in simple admixture with said acid re-

agent, the proportions of said modifying agent being such with respect to the acid reagent as to prevent the latter from deleteriously effecting metallic surfaces with which it comes in contact but without substantially impairing the capabilities of the reagent to react with the fluid-producing formation of an oil or gas well.

6. An acid reagent for treating the producing formations of oil or gas wells to increase fluid production therefrom, comprising a mixture consisting principally of a halogen-containing acid and a relatively small quantity of a compound belonging to the nitrogen group.

7. An acid reagent for treating the producing formations of oil or gas wells composed principally of an acid selected from a group comprising hydrofluoric, hydrochloric and/or nitric acids, and a small quantity of a modifying agent in simple admixture with such an acid to neutralize its normal corrosive action on ferrous metals, said modifying agent being selected from the more metallic-like members of the nitrogen group.

PLAINTIFF'S EXHIBIT 368

Richard H. Carr and Howard C. Humphrey
Method for Introducing Acid Reagents into Oil Wells by Gas Pressures.
Filed Oct. 21, 1932—Serial No. 638,950—Case 177.

This invention relates to an improved process for introducing acid reagents into deep wells, such as those encountered in the oil and gas fields, wherein the reagents

serve to attack the fluid-producing formations of such wells for the purpose of augmenting fluid production therefrom.

It is an outstanding object of the present invention to provide an improved method whereby the delivery of the acid reagent to the producing formation is rendered more positive and certain and effected in a readily controlled manner.

In accordance with the present invention, a selected acid reagent is introduced into the well bore through the customary tubing or casing and permitted to settle to the bottom of the well contiguous to the fluid-producing sands, lime rock or other producing stratum, and wherein the desired penetration of the reagent into the producing stratum is obtained through the employment of gas under pressure, which is so applied to the reagent as to positively force the latter into the pores or interstitial spaces of the producing stratum to attack, disintegrate or partially dissolve matter which tends to obstruct and interfere with the desired flow of fluid into the well bore.

In the accompanying drawing, there is disclosed a diagrammatic figure, partly in vertical section, of a deep well provided with means for carrying out the present invention.

Referring more particularly to the drawing, the numeral 1 designates the well bore, the numeral 2 the string of casing positioned in the bore and opened at its lower end to the producing stratum 3 in contact with the bottom of the well bore 1. Within the casing 2, there is arranged the usual tubing 4 which extends from the producing stratum through the casing head 5 provided at the top of the casing 2 above the ground surface 6. The casing head is provided with the customary valved outlet 7, and the tubing, above the casing head, is provided with a control valve 8.

In practice an acid reagent, which may consist of hydrochloric, muriatic or sulphuric acid or, in certain instances, hydrofluoric or nitric acid, or combinations of these acids, is introduced through the tubing or casing. After a

desired amount of the acid has been so introduced, the outlet 7 is closed as well as the tubing valve 8. Gas is then delivered to the tubing through the pipe line 9 by way of a pump or compressor 10, or from any other suitable source, so that a gas pressure is developed in the tube which forces the acid reagent into the producing stratum, indicated at 3. If desired, a packer 11 may be arranged in the annular space between the lower portion of the tube and the casing 2 so that the reagent will be positively advanced to the producing formation under the gas pressures applied thereto and not forced upwardly of the casing. If the packer is not employed, the annular space between the tubing and casing may be filled with a fluid, such as oil and which possesses a lower specific gravity than the acid reagent in order to assure the delivery of the full quantity of such reagent throughout the fluid-producing area of the well. Again, said annular space may contain a gas under sufficient pressure to prevent the rising of the acid. Also, it is within the range of the invention to introduce the acid reagent through the casing, if desired, rather than the tubing, although as a matter of practice, it is preferred to employ the tubing in this connection.

The reagent so introduced reacts with the producing formation dissolving obstructing matter, enlarging both cavity and pore area and removing obstructive substances which tend to restrict the flow of the desired fluid into the bottom of the well bore. The process thus provides for revivifying wells whose production rate has receded from normal levels and in many instances, the process provides for a much greater output of fluid than that which the well originally produced when first drilled. The process may be applied to newly drilled wells as well as restoring the production rate of old wells. If desired, the treating reagent may contain a small percentage of an arsenic or any other suitable inhibitor to prevent the acid from detrimentally affecting the metallic members in the well bore.

The acid reagent may be introduced directly into the well bore with the ordinary tubing removed, either by being

poured into the bore or by being lowered into the bottom of the well bore in a receptable known as a dump bailer, the upper end of the well bore being closed and gas under pressure, obtained from any suitable source, delivered to the well bore to cause penetration of the reagent into the producing formation.

What is claimed is:

1. The method of introducing acid reagents into the producing stratum of a deep well, which consists in passing such a reagent through the tubing of a well into the vicinity of the producing formation, obstructing the well bore to retain the acid in the vicinity of the producing formation and to overcome any tendency thereof to rise in the well bore, and applying gas pressure to the acid reagent to positively advance the latter through desired areas of the producing formation.

2. The herein described method for introducing acid reagents into the producing formations of oil wells and the like, which consists in delivering the acid reagent to the bottom of the well bore in the immediate vicinity of the fluid producing formation of such a bore, retaining the reagent in the bottom of said bore against movement in an upward direction through said bore, and applying gas pressures to the acid reagent to positively advance the latter through the pores and interstitial spaces of the producing formation contacting the well bore.

3. The herein described method for introducing an acid treating reagent into the producing formation of a well bore, which consists in delivering the reagent to the bottom of said bore in the immediate vicinity of the producing formation, sealing the bore against the rise of the reagent therein, and then applying gas pressures to the reagent to force the latter through the pores and interstitial spaces of the producing formation.

4. The herein described method for introducing an acid treating reagent into the producing formation of a well bore, which consists in passing the acid reagent through the customary tubing of a well bore and delivering

the same to the bottom of the bore in contact with the fluid-producing region of said bore, sealing the customary casing of the well bore to prevent the rise of the reagent in said casing and around the tubing and forcing a gaseous fluid under pressure into said tubing and in contact with the acid reagent to positively advance said reagent through the pores and interstitial spaces of the producing formation.

5. The herein described method for introducing an acid treating reagent into the producing formation of a deep well, which consists in suitably depositing the reagent in the bottom of the well bore contiguous to the producing formation, and causing penetration of the reagent into the producing formation by the application to the reagent of a gas under pressure.

6. The herein described method for introducing an acid reagent into the producing formation of a deep well, which consists in passing such a reagent through the tubing of a well into the vicinity of the producing formation, sealing the annular space formed between the tubing and the customary surrounding casing with a fluid, and forcing gas under pressure through the tubing to cause the acid reagent to penetrate the producing formation.

7. The herein described method of introducing acid reagents into the producing stratum of a deep well containing the customary casing and tubing, which consists in passing an acid reagent through the tubing and delivering the same to the bottom of the well bore contiguous to the producing stratum, introducing a gas under pressure through the tubing and into contact with the acid reagent to positively advance the latter into the producing stratum, and maintaining a body of gas under pressure in the annular space formed between the tubing and casing to prevent the rise of the reagent into said space while gas pressures are being applied to the reagent to cause penetration thereof into the producing stratum.

PLAINTIFF'S EXHIBIT 369

This Agreement, made and entered into this 31st day of January, 1933, by and between The Dow Chemical Company, a corporation organized under the laws of Michigan, with its principal office at Midland, Michigan, hereinafter referred to as Dow, party of the first part, and The Pure Oil Company, a corporation organized under the laws of Ohio, with its principal office at 35 East Wacker Drive, Chicago, Illinois, hereinafter referred to as Pure, party of the second part, Witnesseth:

Whereas, Dow has developed a solvent which, when applied to a producing oil well, is intended to cause greater porosity of the oil bearing strata and thereby increase production; and, for its protection in the manufacture, use and sale of said product, has obtained United States Letters Patent 1,877,504 entitled "Treatment of Deep Wells"; and

Whereas, Dow has continued its research and developed other products and materials for the treatment of deep wells which may be used in connection with said solvent or separately on which United States Letters Patent have been applied for; and

Whereas, Dow is equipped to manufacture and transport such products and to supervise the treatment therewith of oil producing wells and provide facilities for such purposes; and

Whereas, Pure is a large producer of oil and other petroleum products and operates many producing wells in Michigan and various other states and has also been actively engaged in research work on the treatment of oil wells to increase production therefrom and has devised a new and novel process for the introduction of acid into wells and, for its protection in reference thereto, has obtained United States Letters Patent 1,891,667 entitled "Method of Facilitating the Flow of Wells"; and Pure has continued its research upon the treatment of oil wells and has made further discoveries and inventions and, for the

issuance of patents thereon, applications are now pending; and

Whereas, in the treatment of its oil and gas wells Pure uses an inhibited acid known as Dowell-X and it is mutually desired that Dow shall continue as Pure's source of supply for its Dowell-X and other inhibited acids;

Now therefore, in consideration of the mutual covenants herein contained, the parties hereto agree as follows:

I.

Dow shall grant unto Pure without royalty charge a non-exclusive license under Patent 1,877,504 and under any other patents which Dow may acquire, own or control relating to acid treatment of oil or gas wells.

II.

Pure shall grant unto Dow and its subsidiaries a non-exclusive license under Patent 1,891,667 and under any other patents which Pure may acquire, own or control relating to acid treatment of oil or gas wells. Dow shall pay Pure in manner hereinafter specified a royalty of $5.00 for each and every well which shall be treated by Dow, its subsidiaries, agents or representatives after the execution of this contract, until the royalties so paid shall amount to $15,000 whereupon said obligation to pay royalty shall terminate. Pure agrees to accept capital stock in Dowell Incorporated in lieu of cash for royalty that may accrue, with the understanding that when accrued royalty shall amount to $5000 Dowell Incorporated shall issue unto Pure a certificate for fifty shares of its $100 par value capital stock. At each time thereafter when accrued royalty shall amount to $5000 a certificate to Pure for fifty additional shares shall likewise be issued until Pure's holding of capital stock in Dowell Incorporated shall have reached $15,000.

III.

Pure hereby acknowledges the validity of Dow's Patent 1,877,504, and Dow likewise acknowledges the validity of Pure's Patent 1,891,667. The parties mutually agree to cooperate with each other for the protection of the licensed patents with the understanding, however, that neither of the parties shall be obligated to the other beyond furnishing, without charge, services of attorneys and other technical employees under general salary or retainer.

IV.

Pure agrees wherever practicable in the major producing fields in the East and Southwest to permit Dow to utilize Pure's facilities for the handling of acid treatment of wells upon condition, however, that Dow shall pay a reasonable rental or service charge for use of such facilities.

V.

Dow hereby agrees to sell to Pure and Pure agrees to purchase and accept from Dow the merchandise herein described for a period of ten years from the date hereof (subject to certain limitations hereinafter recited) according to terms and conditions named below:

Article—Dowell-X, or other inhibited acids.

Quality—Same as now currently supplied by Dow to Pure, namely, 15% Acid Inhibited and/or 20% Acid inhibited, as required by Pure.

Quantity—Pure's requirements for its own use only and not for resale, not exceeding 50,000 gallons per month. It is understood that this clause in no way limits Pure in the quantity of acid it may buy and use in the treatment of its oil and gas wells but is intended only to limit the quantity of acid which Dow may be required to deliver to Pure. In event Pure's requirements exceed 50,000 gallons

per month, Dow shall be given the opportunity of supplying same at competitive prices and, in event of Dow's declining to so supply, Pure may purchase such excess requirements in the open market.

Package—Tank cars or containers furnished by Pure.

Price—(A) For such acid as Pure desires to take from Dow's plant at Midland, Michigan, the price shall be $50.00 per thousand gallons for the 15% acid inhibited and $68.35 per thousand gallons for the 20% acid inhibited, all prices f.o.b. plant, Midland, Michigan.

(B) For Pure's use at points distant from the Midland field where Dow has a supply of acid through arrangements with local producers of acid at such remote points, Dow will make it possible for Pure to secure such acid at the cost of the raw acid to Dow, plus a reasonable price for the inhibitor used, if supplied by Dow, and plus a reasonable charge for compounding or diluting where Dow is equipped to and does so dilute or compound said acids.

Terms—One per cent ten days, thirty days net; payable in gold or its equivalent in United States currency.

Deliveries—Pure shall give Dow reasonable notice covering shipments and shall take deliveries in approximately equal monthly quantities.

It is agreed that upon Pure's written request other acid compounds may be substituted for Dowell-X, providing that such compounds are to be used in the treatment of oil and gas wells, and in such event suitable adjustments will be made and the price determined by the relative acid content in such other compounds as compared with Dowell-X, and shall be further corrected for greater or lesser cost involved in the manufacture.

It is mutually agreed that either of the parties hereto may terminate this agreement on the 31st day of December, 1937, or on the 31st day of December in any succeeding year, by giving written notice to the other at least sixty days prior to the date of cancellation.

Neither party shall be held responsible for any default occasioned by war, fire, strike, accident, civil or military authority, or other contingencies beyond its control.

In Witness Whereof the parties hereto have caused these presents to be executed by their officers duly authorized on the day and year aforesaid, and have hereunto caused their respective corporate seals to be affixed.

The Dow Chemical Company
By Willard H. Dow, President.

Attest: Earl W. Dimmitt,
Assistant Secretary.

The Pure Oil Company,
By R. Wm. Ilvane, Vice-President.

Attest: H. Guy Chase,
Asst. Secretary.

PLAINTIFF'S EXHIBIT 370

This Agreement, made and entered into this 30th day of June, 1934, by and between The Dow Chemical Company, a corporation organized under the laws of Michigan, with its principal office at Midland, Michigan, hereinafter referred to as Dow, party of the first part, and The Pure Oil Company, a corporation organized under the laws of Ohio, with its principal office at 35 East Wacker Drive, Chicago, Illinois, hereinafter referred to as Pure, party of the second part, Witnesseth:

Whereas, Dow has developed a solvent which, when applied to a producing oil well, is intended to cause greater porosity of the oil bearing strata and thereby increase production; and, for its protection in the manufacture, use

and sale of said product, has obtained United States Letters Patent 1,877,504 entitled "Treatment of Deep Wells"; and

Whereas, Dow has continued its research and developed other products and materials for the treatment of deep wells which may be used in connection with said solvent or separately on which United States Letters Patent have been applied for; and

Whereas, Dow is equipped to manufacture and transport such products and to supervise the treatment therewith of oil producing wells and provide facilities for such purposes; and

Whereas, Pure is a large producer of oil and other petroleum products and operates many producing wells in Michigan and various other states and has also been actively engaged in research work on the treatment of oil wells to increase production therefrom and has devised a new and novel process for the introduction of acid into wells and, for its protection in reference thereto, has obtained United States Letters Patent 1,891,667 entitled "Method of Facilitating the Flow of Wells"; and Pure has continued its research upon the treatment of oil wells and has made further discoveries and inventions and, for the issuance of patents thereon, applications are now pending; and

Whereas, in the treatment of its oil and gas wells Pure uses an inhibited acid known as Dowell-X and it is mutually desired that Dow shall continue as Pure's source of supply for its Dowell-X and other inhibited acids;

Now therefore, in consideration of the mutual covenants herein contained, the parties hereto agree as follows:

I.

Dow hereby grants unto Pure without royalty charge a non-exclusive license under Patent 1,877,504 and under any other patents which Dow may acquire, own or control, relating to acid treatment of oil or gas wells upon condition, however, that said license shall be limited and restricted in its use to the treatment by Pure of its own wells within Michigan.

II.

Pure hereby grants unto Dow, its subsidiaries and assigns, a license with right to sublicense others, exclusive except as to Pure, under Patent 1,891,667 and under any other patents which Pure may acquire, own or control during the existence of this agreement and relating to the acid treatment of oil or gas wells for the full term or terms of any such patent or patents. Dow shall pay unto Pure a royalty of five dollars for each and every well which shall be treated by Dow, its subsidiaries, sublicensees, agents or representatives after the execution of this contract; provided, however, that such royalty shall not apply to any wells treated by Pure. Dow shall keep proper records of the wells treated hereunder and within thirty days from the last day of each calendar quarter shall furnish to Pure a statement of the total number of wells treated in any such calendar quarter and at the same time account and pay over to Pure all royalties which shall have accrued for its account. Pure consents and agrees that if its Patent 1,891,667 shall be held invalid in whole or in substantial part by a court of last resort or by a court of competent jurisdiction from whose decision no appeal is taken within the time limit therefor, or if Dow shall discontinue the treatment of oil and gas wells, it may forthwith cancel and terminate this contract, any provision herein to the contrary notwithstanding. In event, however, that Dow shall sell to others its well treating business, any such sale shall be expressly subject to the provisions of this contract, and the assignee shall assume payment of royalties and all other covenants herein to be performed by Dow.

III.

Pure hereby acknowledges the validity of Dow's Patent 1,877,504, and Dow likewise acknowledges the validity of Pure's Patent 1,891,667. The parties mutually agree to cooperate with each other for the protection of the licensed patents with the understanding, however, that neither of

the parties shall be obligated to the other beyond furnishing, without charge, services of attorneys and other technical employees under general salary or retainer. Dow shall have the right at any time and from time to time to institute suit at law or in equity and to prosecute the same in its own name and/or in the name of Pure against any infringer of any patent owned or controlled by Pure pertaining to the acid treatment of oil or gas wells; provided, however, that no such suit shall be brought by Dow unless before instituting said suit Dow shall have first requested Pure to bring suit and Pure shall have neglected or refused so to do. Dow shall, in the absence of an agreement with Pure to the contrary, bring suit at its own expense and shall retain all damages or money awards therefrom.

IV.

Pure agrees that Dow or its subsidiaries shall have the first right or refusal to treat any and all wells of Pure outside of Michigan which Pure may desire to have treated, upon the basis of Dow's standard price for treating in such territory, less twenty per cent, less an additional $25 which represents royalty paid to Dow. In event Pure shall desire to treat its own wells in any territory outside of Michigan, Dow hereby authorizes it so to do upon condition, however, that it shall pay unto Dow a royalty of $25 for each and every well treated by Pure outside of Michigan.

V.

Dow hereby agrees to sell to Pure and Pure agrees to purchase and accept from Dow the merchandise herein described for a period of ten years from the date hereof (subject to certain limitations hereinafter recited) according to terms and conditions named below:

Article—Dowell-X, or other inhibited acids.

Quality—Same as now currently supplied by Dow to Pure, namely, 15% Acid Inhibited and/or 20% Acid Inhibited, as required by Pure.

Quantity—Pure's requirements for its own use only and not for resale, not exceeding 50,000 gallons per month. It is understood that this clause in no way limits Pure in the quantity of acid it may buy and use in the treatment of its oil and gas wells but is intended only to limit the quantity of acid which Dow may be required to deliver to Pure. In event Pure's requirements exceed 50,000 gallons per month, Dow shall be given the opportunity of supplying same at competitive prices and, in event of Dow's declining to so supply, Pure may purchase such excess requirements in the open market.

Package—Tank cars or containers furnished by Pure.

Price—(a) For such acid as Pure desires to take from Dow's plant at Midland, Michigan, the price shall be $50.00 per thousand gallons for the 15% acid inhibited and $68.35 per thousand gallons for the 20% acid inhibited, all prices f.o.b. plant, Midland, Michigan.

(b) For Pure's use at points distant from the Midland field where Dow has a supply of acid through arrangements with local producers of acid at such remote points, Dow will make it possible for Pure to secure such acid at the cost of raw acid to Dow, plus a reasonable price for the inhibitor used, if supplied by Dow, and plus a reasonable charge for compounding or diluting where Dow is equipped to and does so compound or dilute said acids.

Terms—One per cent ten days, thirty days net; payable in gold or its equivalent in United States currency.

Deliveries—Pure shall give Dow reasonable notice covering shipments and shall take deliveries in approximately equal monthly quantities.

It is agreed that upon Pure's written request other acid compounds may be substituted for Dowell-X, providing that such compounds are to be used in the treatment of oil and gas wells, and in such event suitable adjustments will be made and the price determined by the relative acid content in such other compounds as compared with Dowell-X, and shall be further corrected for greater or lesser cost involved in the manufacture.

It is mutually agreed that either of the parties hereto may terminate paragraph V of this agreement on the 31st day of December, 1937, or on the 31st day of December in any succeeding year, by giving written notice to the other at least sixty days prior to the date of cancellation.

Dow shall purchase at par Pure's holding of capital stock in Dowell Incorporated, that is to say, Dow shall pay Pure $5000 (less any dividends already paid thereon) for fifty shares of said capital stock. Dow shall promptly pay to Pure upon execution of this agreement all additional royalty which shall have accrued to Pure under the provisions of paragraph II of an agreement between the parties hereto dated January 31, 1933. It is further understood and agreed that this contract shall supersede and terminate the said agreement dated January 31, 1933.

Neither party shall be held responsible for any default occasioned by war, fire, strike, accident, civil or military authority, or other contingencies beyond its control.

In Witness Whereof the parties have caused these presents to be executed by their officers duly authorized on the day and year aforesaid, and have hereunto caused their respective corporate seals to be affixed.

The Dow Chemical Company
By Willard H. Dow, President.

Attest: James T. Pardee,
Secretary.

The Pure Oil Company
By R. Wm. Ilvane, Vice-President.

Attest: A. C. Harvey,
Asst. Secretary.

DEFENDANT'S EXHIBIT 8

REPORTS OF INVESTIGATIONS
DEPARTMENT OF THE INTERIOR—BUREAU OF MINES

Serial No. 2550, December, 1923

THE PARAFFIN PROBLEM IN OIL WELLS

By R. Van A. Mills[x]

[x]Petroleum engineer, Bureau of Mines, Department of the Interior.

Introduction.

This preliminary paper is intended to answer briefly some of the inquiries coming to the Bureau of Mines regarding the so-called "paraffining" of oil wells and methods of preventing and remedying that trouble. The increased difficulties in operation and the losses of production caused by the deposition of gummy and waxy hydrocarbons commonly called paraffin, in the wells, tubing, other pumping equipment, and in the pores of the productive sands, have long been recognized but the trouble has not been overcome. The nature and causes of the trouble, together with some of the possible methods by which it may be diminished or overcome, are outlined below.

Hydrochloric Acid. The Bureau of Mines has experimented with the use of hydrochloric acid following the treatment of a well with sodium peroxide. The purpose of this acid treatment was to dissolve calcium carbonate which, together with paraffin, plugged the pores of the sand around the walls of the hole. Several carboys of concentrated acid were dumped into the well by inverting the carboys on top of the open casing head, and allowing the acid to run down the casing. (A dump bailer might be used to keep the acid off the casing.) The acid was introduced after the sodium peroxide had stopped its violent reaction. The introduction of the hydrochloric acid which mixes with the sodium hydroxide resulting from the preceding reaction

gives another violent reaction with considerable heat. By adding an excess of acid, the calcium carbonate, silt, crusts, and interstitial matter is cleaned out by being dissolved. The acid may be permitted to stand in the well a few days but should then be bailed out together with loose sand, silt, and water.

DEFENDANT'S EXHIBIT 72

Prairie Depot, Ohio,
Dec. 5th, 1895

J. W. Van Dyke,
Lima

Dear Sir:

We were disappointed in getting away from Findlay on Tuesday morning and were detained there until Tuesday night. We arrived in Prairie Depot on Wednesday morning and I arranged with Mr. Gorden for some 1" tubing and told him to have same charged to you. We coated it with paint you had expressed here. Our tools and tubing were held in Fostoria from Monday night until on Wednesday morning when we came through there I saw them and as soon as I reached here I telegraphed for them and they were brought here on Wednesday P.M. The fact that the tools did not get here sooner has caused no delay on our part for they did not get the rig built in time to have the tubing pulled from the well before the afternoon of Wed-

nesday. I got our tubing and tools hauled to well on Wednesday evening and we tubed the well and got everything ready today to dump acid in the morning. The line to deliver water to the well is a temporary overground line and after we were all ready today we helped pumper to tear up, thaw out and relay the water line to make sure it would be so we could use it tomorrow. I sincerely hope to be through with this well in time to be in Lima Saturday night. I remain

Yours truly
M. G. Harper

DEFENDANT'S EXHIBIT 73

Lima, O., Jan. 24, 1896

From Blufton, Ind. 23 1896 No. 6792

To J. W. Van Dyke

Send man to Geneva tomorrow. Will meet him there noon train.

E. W. Harmon

Foned to Howard Nichols at 8:50 P.M.

Lima (Service)

Mime. 23 J. W. Van Dyke signed Harmon is Supt. Standard Rf. If he is not at home dely. to some one in charge his place.

Bluffton, Ind. 23

DEFENDANT'S EXHIBIT 74

Mr. J. W. Van Dyke

I herewith hand you all the written information about the acid wells which I have. There are some breaks in the gauges, the reasons for which I could not give now but you can get about the run of it from these telegrams. Sorry that I could not give it to you in a tabulated form but pressure of business prevents. After you are through with these would like them returned to me.

In haste,
C. F. Lufkin

DEFENDANT'S EXHIBIT 83

Lima, O., Nov. 25, 1895

From Findlay 25, 1895 — No. 5790

To J. W. Van Dyke

Will be ready as soon as acid gets there.

J. C. Donnel

Notation.

Phoned C. F. Lufkin at 8:25 P.M.—Sat'y. 23"

DEFENDANT'S EXHIBIT 86

Lima, O., Dec. 6, 1895

From Prairie Depot 25 1895 — No. 5984

To J. W. Van Dyke

All ready this evening. Will commence to dump acid early in morning.

M. G. Harper

DEFENDANT'S EXHIBIT 88

THE GRASSELLI CHEMICAL CO.
Cleveland, Ohio

July 26, 1895

Mr. J. W. Van Dyke
c/o Solar Refining Co.
Lima, O.

Dear Sir:

In reply to your favor of the 25th would say that we have had an interview with Mr. Frasch today and have decided to make you a price on Muriatic Acid of 85 cents delivered. This is the lowest price we are making any of our large consumers and is for delivery in carboys.

Should you be in position to use it in tank cars we could ship it to you in tank cars at 10 cts. per 100# less, but this would necessitate your drawing it off into carboys on arrival, at your own expense.

Hoping to receive orders from you soon, we remain,

Yours very truly,

The Grasselli Chemical Co.
per A. E. Whiting

DEFENDANT'S EXHIBIT 90

City, Sept. 22nd, 1895

Dear Van:

I did not get away this morning. Mrs. F. and Frieda are going at noon, and I am going to see them off. I will leave tonight and expect to be at the ——— Wednesday morning.

I saw Mr. Baily of the Grasselli Company, Mr. Grasselli not being home yet. They say Rob must have made a mistake as to the 16% business. He says it was 10 Baume, ought to have been 16° Baume in hot weather without deduction for temperature, but that it contained 27 or 28% acid. About the stronger acid it is made in cast-iron cylinders and contains less sulphuric, but is not as cheap. He no doubt would like us to use the 18° B. acid. I told him to let you know what they could do on stronger acid with less sulphuric. Price, etc. Write at once to Pittsburgh and see what the acid co. there can do. State we would use and are using large quantities. I enclose Hedrick's letter. I would not spend any money for the oil packing as it is not essential. The patents are good and strong. I will send him the money when I get back. I will also have the list of foreign ———. I think, however, that Canada is the only country we need take out a patent and we can do that any time. We have six months to do as we please. I will have to see Hedrick about that interference anyway. Then I will take the matter up and talk it over with him. Treat as many wells as you think best and do the best you can. Write or wire me if anything important turns up.

Good-bye.

Yours truly,

Herman

DEFENDANT'S EXHIBIT 101

Dec. 16, 1895.

Mr. J. W. Van Dyke,
Lima, O.

Dear Sir:

I suppose there should be a new string of tubing sent down to use on the Neeley well, as the one we have will be pretty well used by the time we get through on the Arnot well. We should have four new 1" cocks also 4—1" nut unions.

Yours respy.
M. G. Harper.

Mr. McCart. please to see to shipping the above and buy it charged to me.

J. W. V. D.

Mr. McCart: This 1" pipe should have 2 coats of paint.

DEFENDANT'S EXHIBIT 102

Dec. 16th, 1895

Mr. J. W. Van Dyke,
Lima, O.

Dear Sir:

We were to the Arnot well today but have not made very satisfactory progress. Their tubing rope did not get to the well u..til in the afternoon and they did not have the proper amount of help to pull rods and tubing with and we helped them all afternoon.

We will not get to pour acid tomorrow. The Buckeye people have a duplex pump at the well which they have been using to run the oil from the well and I have gotten permission from them to use it in the treating of the well to pump the oil and water with. This well pumped 4½" of oil from Saturday morning at 7 o'clock until 12 o'clock on Saturday night and it done 9½" from 12 o'clock on Sunday night until noon today.

I got a piece of the rock from the well today which looks very promising. We will not be able to pour acid before Wednesday morning as we got nothing done today but to help them. We will have our pump to connect up, water lines to lay, and the well to tube tomorrow, besides helping them to pull balance of their tubing.

I remain respy. yours,

M. G. Harper

DEFENDANT'S EXHIBIT 103

THE OHIO RUBBER CO.
Cleveland, O.

Sept. 21, 1895.

Solar Refining Company,
Lima, Ohio.
Gentlemen:

Pursuant to our telephone conversation with your Mr. Frasch in regard to lining gas pipe with a rubber tube suitable to withstand hydrochloric acid, we have taken the matter up with our factory and asked them to advise us at an early date if they can do this work, also asking them for price per-foot for lining 1" gas pipe with 1.8" tube. As soon as we hear from our factory we will notify you immediately.

Yours very truly,
Ohio Rubber Company
G. N. Talcott

DEFENDANT'S EXHIBIT 104

THE OHIO RUBBER CO.

Cleveland, O., Sept. 25-1895.

Solar Refining Co.,
Lima, Ohio,
Gentlemen,:

In regard to lining 1" gas pipe with rubber about which we wrote you recently, our factory reports that they think it will be a difficult matter to line this pipe so it will give you satisfaction. Gas pipe as you know is very dirty and sometimes greasy inside and any dirt or grease would of course have to be removed in order for the rubber to vulcanize to the iron. On so small a pipe as 1", it would be a difficult matter to clean it properly and we are in doubt whether we would be able to make the tube adhere to the iron. Another difficulty arises in coupling the gas pipe, you might loosen the tube at the end of the pipe where it was cemented allowing the acid to get in back of the rubber which would soon spoil the tube and we are of the opinion that we could not do you a satisfactory job. We would suggest that in place of gas pipe you use rubber hose, although we do not know under what conditions it would be used but we think a rubber hose would give you better service. Should you decide to put in rubber hose we would be pleased to figure with you.

Yours very truly,
Ohio Rubber Company
G. N. Talcott

DEFENDANT'S EXHIBIT 105

The Crossley well No. 3, owned by The Ohio Oil Co., located 1½ miles S. E. of Lima.

5⅝" casing, depth of well 1286 ft. 1/3 of a screw of loose sand, balance tight and hard.

Age of well when treated six months. Was shot after drilling in and the first 30 days did not produce gas and oil sufficient to make fuel to run and had to use wood. The records show the average daily production to be 1.6 barrels. From best information I can get the well was possibly doing one barrel per day before treating.

Commenced treating Aug. 5th; finished treating August 10, 1895.

DEFENDANT'S EXHIBIT 108

Prairie Depot, O., Feb. 5th, 1896

J. W. Van Dyke,
Lima, O.

Dear Sir:

We are strictly in the fishing business. We have been fishing until this P.M. about 3:30 o'clock trying to pick up a sand line which is in the hole and as yet we have failed to do so and we then abandoned the idea of getting a hold on the sand line and commenced putting ¾″ tubing into the hole in hopes that we may be able to get to the bottom of hole and loosen up the tools and then the cable will bring the sand line up with it as we pull the tools out.

I saw Mr. Gordon this evening and he says the well (Mary Richard #1) still continues to make its 6″ of oil each day. I have not been permitted to go out to see the well as yet, but will do so before I leave here.

I trust we may get tubing to bottom of hole and get the acid in tomorrow, but it is hard to say what progress will make tomorrow. The sand line seems to have fallen and bunched about 150 ft. from the top and we have been successful in getting 457 ft. of tubing in, which puts the bottom of tubing 307 ft. below where the sand line is fast in the hole.

Respy. yours,
M. G. Harper

DEFENDANT'S EXHIBIT 109

July 25, 1895.

Mr. C. F. Lufkin,
Ohio Oil Co.,
Lima, Ohio.

Dear Sir:

You will no doubt remember our conversation at your house last week, in reference to improving the flow of oil wells by the use of acid, and you will also remember, I presume, that at that time you thought you might, under certain conditions, furnish us one of your wells for trial.

If, after mature thought on this subject, you see sufficient possibility in this method to warrant your encouraging it, I would make the following proposition:

If you will furnish us a well comparatively new, reasonably free from salt water and in producing territory, by this I mean to convey to you that we want an oil well which there would be a chance of improving with our method; we do not want a dry hole, or a well in such a condition that nothing would improve it.

We will furnish the acid and pipe and place the acid in the well at our own expense. However, we would suppose you would remove the tubing and rods and re-tube, assuming you would prefer to do this. If we do not improve the well, then you are out only the expense of taking out your tubing and replacing it, and such other small costs as would naturally follow. On the other hand, if we improve the flow of the well sufficient to warrant your paying us for our material, then we would expect you to do so. As to this, you to be the judge.

The object of making this test would be to determine the merits of our method, therefore we would expect to have as far as possible the history of the well, its present production, and after the experiment has been tried to have free access and opportunity to see for ourselves if we have improved it.

Please consider this proposition, and if you believe there is enough in our method to warrant you in having same tried, please advise me with as little delay as possible, as I am getting quite anxious to bring this matter to a conclusion. On the other hand, should you not see any advantage to be gained to your interest by trying this, and should not wish to do so, please advise me.

It might be well to advise you that I have arrangements made for the acid, so the trial can be made without much delay.

Yours respectfully,
J. W. Van Dyke.

THE OHIO OIL COMPANY

Findlay, O., Feb. 13, 1896.

Mr. C. F. Lufkin,
Lima, Ohio.

Dear Sir: I herewith enclose you Mr. Van Dyke's bills and checks for the same as per your request of this morning. It seems to me that this is a most unreasonable charge for an experiment that Mr. Van Dyke expected to be benefitted by; he has figured in every possible item of expense that he was to in trying this experiment with these wells. The way the matter stands we have got a good deal of oil out of the Taylor well, in the 3 months since the well was treated I figure that we are ahead about 1500 barrels which would amount to about $1200. In addition to Mr. Van Dyke's bills we had to pump the well tour at a cost of $110.00 a month for pumpers, we were compelled to get a string of tubing for the well at a cost of about $312.00 and also a string of big rods at an expense of about $78.00. This does not include a great deal of other labor we put on this well in addition to setting and furnishing a boiler and engine to pump the well.

The Cusac well we had to clean out after Mr. Van Dyke got through at an expense of about $50. This well

was not improved any, consequently we got no benefit from the experiment.

I enclose you a little Summary showing how we stand on the experiment to date.

Yours truly,
(Signed) J. C. Donnell

THE OHIO OIL COMPANY

Production, R. Crossley Farm:

June		86.24
July		180.01
August		194.43
September		238.66
October		259.49
November		208.83
December		92.26
January		148.37
	8	1408.29
	30	176.04
		5.87

THE OHIO OIL COMPANY

Lima, Ohio, February 22nd, 1896.

Mr. J. W. Van Dyke,
Gen'l Manager Solar Refinery.
Lima, Ohio.

Dear Sir:

Since talking with you this morning I have been examining your bill more critically and have made a little table of the cost of putting the acid in the wells. It develops some funny looking charges at least. First, the teaming is about twice as much for the Crossley well as any other

well, where the distance and roads were the shortest and best. Then Harper's charge for the Taylor well is the greatest where the acid went in the well with the least trouble. You will also see that Harper's time for the Crossley and the Cusac wells differs only twenty-one cents which at his rate would be for only five or six minutes, showing wonderful skill on his part in keeping time. The other labor is the *least* on the well on which Harper's time is the greatest, and his time would figure out at the rate of about $15.00 or $18.00 per day, which is pretty high.

These are a few of the most striking inconsistencies. I really believe, Van, that you can improve on this bill. Suppose you try it.

Yours truly,

M. C. F. Lufkin

THE OHIO OIL COMPANY

Extra Pumpers at Taylor well (3 months at $110.00)		$ 330.00
String of 3 inch tubing at Taylor well....		312.00
String of big rods for Taylor well........		78.00
Cleaning out Cusac well................		50.00
J. W. Van Dyke bill for Taylor well.....		357.21
J. W. Van Dyke bill for Cusac well......		391.78
Amount ahead account Taylor well......	$1200.00	
	$1200.00	$1518.99

THE OHIO OIL CO.

Lima, Ohio, February 25th, 1896.

Messrs. J. W. Van Dyke & Herman Frasch,
Lima, Ohio.

Gentlemen:

Herewith you will please find three checks of The Ohio Oil Company amounting to one thousand three hundred and ninety-three dollars and eighty-two cents, ($1393.82), in

payment of the four vouchers enclosed, which you will please sign and return to me. What may appear like a seeming delay to you has arisen wholly from the fact that the wells were located in different parts of the Field under different Division Superintendents, and that our General Manager, Mr. William Fleming had requested to see the bills before they were paid; all of which has been done as expeditiously as possible, when all the circumstances connected with the matter are considered.

Yours truly,
C. F. Lufkin
General Superintendent.

DEFENDANT'S EXHIBIT 110

THE OHIO OIL CO.

Lima, Ohio., July 29th, 1895.

J. W. Van Dyke, Gen. Mgr.,
The Solar Refining Co.,
Lima, Ohio.

Dear Sir:—

Replying to yours of the 25th, containing a proposition to introduce acid into an oil well owned by The Ohio Oil Company, for the purpose of increasing the production of oil, I beg to say; that the conditions you impose are satisfactory as far as they go, but to avoid any misunderstanding, I will make a counter proposition as follows:

Defendant's Exhibit 110

The Ohio Oil Company will furnish you an oil well in some part of the Lima field which has been torpedoed and is producing oil in paying quantities. We will allow you access to the well, and give you any information we have concerning it, before the acid is introduced, and also afterwards, so that you may be able to form your own estimates of its production. You are to furnish the acid for and introduce it into the well at your own expense; and after it has remained sufficiently long to do the work which you desire it to accomplish, if the well is found to be filled up with sediment, caused by introducing the acid, you are at your own expense to furnish tools and men to clean the well out, and remove all the sediment to its original depth.

The Ohio Oil Company will remove the tubing and rods and replace the same at their expense.

At the end of thirty days, after the well has been put to pumping in a successful way, if the production has been sufficiently increased to warrant the Ohio Oil Company's reimbursing you for the cost of the acid at the well, also the cost of cleaning the well out, The Ohio Oil Co. will pay you such costs; The Ohio Oil Company to be the judge, whether the production has been sufficiently increased to warrant such payment.

I have in mind now, a well located on the Crossley farm, about three miles east of this city; it is only a month or six weeks old, and a fair producer: I cannot now state its amount, but feel sure that you will be satisfied with its location, and surroundings, and the opportunity it will afford you of determining the merits of your method of increasing the production of oil wells.

A copy of the above will be furnished William Fleming, our General Manager, and will be subject to his approval.

Very truly yours,
C. F. Lufkin.

DEFENDANT'S EXHIBIT 111

Dec. 2nd, 1895

J. W. Van Dyke,
Lima, Ohio
Dear Sir:

Mr. Angel says to tell you they (The Walker Oil Co.) have 4 wells near Helena, (one of them being the well I spoke to you about over the phone) which they will want acid in if it proves satisfactory on the first one. They are wells that started off at from 35 to 50 barrels and have now fallen away to from 5 to 8 barrels. The 4 wells he tells me do about 10 barrels of water in a week. They are situated close together and are pumped with shackle rods. The haul from R.R. to wells is about one mile. The distance the wells are in sand is about 60 ft. with a total depth of about 1300 ft. As regards the pay for the well I told him I thought you would take the increased production until the job was paid for, which he considered very reasonable, but also spoke of paying for it on the 30-60 and 90 day plan which I told him would be satisfactory to you I thought. He wanted me to set a price on treating one well to which I replied that it would be very near $500.00.

I made no decisive answer thus leaving room for you to make it higher if I am too low. He said he would like you to write him concerning the well. His address is C. B. Angel, Findlay, Ohio.

I remain yours truly,
M. G. Harper

DEFENDANT'S EXHIBIT 112

THE GRASSELLI CHEMICAL CO.
Cleveland, Ohio

Nov. 21st, 1895

Mr. J. W. Van Dyke,
Lima, Ohio.

Dear Sir:

We shipped yesterday car 7762 D consigned to Findlay —we have asked the L. S. & M. S. to trace it and they tell us that it will arrive at Findlay tomorrow.

Car 15902 N. Y. C. & St. L. was pulled out of our yard today consigned to Prairie Depot.

The N. Y. C. & St. L. people will trace it and we will advise you tomorrow when delivery will be made.

Yours truly,
The Grasselli Chemical Co.
(Signed) A. E. Whiting

DEFENDANT'S EXHIBIT 113

THE SOLAR REFINING COMPANY

Lima, Ohio, Nov. 20, 1895.

Grasselli Chemical Co.,
Cleveland, O.

Gentlemen:—In reference to our order dated Nov. 19th for a car load of hydro-chloric acid to be shipped to Prairie Depot, and one to Findlay, Ohio, we telegraphed you today as follows:

"Change our order of yesterday shipping first car to Findlay."

We found it necessary to make this change, as we wish to treat the well at Findlay first, then follow with the well at Prairie Depot.

In both cases we want you to ship large cars. Would ask that you rush the shipment to Findlay and follow with tracer, then follow with the shipment to Prairie Depot as soon after as you can, advising me what time we can expect the cars to arrive at the different places.

Yours truly,
J. W. Van Dyke

DEFENDANT'S EXHIBIT 114

Nov. 21, 1895

Mr. Harper starts tomorrow morning for Findlay to treat the Cusic well belonging to the Ohio Oil Co. 4 miles west of Findlay. He then goes to Prairie Depot and there treats a well, that is not yet named, for the Ohio Oil Co. I give Mr. Harper $125 in cash. The acid was shipped in his name. Mr. Harper stops at the American House in Findlay.

DEFENDANT'S EXHIBIT 115

Dear Van:

I am going South tonight to see the rubber people. They will write you about the pipe. They say they can coat it outside and inside. I have an engagement with the Grasselli now. I obtained a letter from Hedrick that our patents are allowed. We better let that rest till I return. I just received word from N. Y. that I could go. About wells use your judgment. Good bye and will write again.

H. Frasch

DEFENDANT'S EXHIBIT 132

THE GRASSELLI CHEMICAL CO.
Cleveland, Ohio

Mr. J. W. Van Dyke, July 19, 1895.
Gen. Mgr. Solar Refining Co.
Lima, Ohio

Dear Sir:

Your esteemed favor of the 17th, addressed to our President, Mr. C. A. Grasselli, came duly to hand, but regret to say that he is out of the city and will be for some days. Would suggest, however, that if you will require any Hydrochloric Acid in the meantime, to forward us the orders and the price can be adjusted on Mr. Grasselli's return.

Your request as to treating the subject confidentially shall certainly be complied with.

Yours very truly,
The Grasselli Chemical Co.
H. C. Grant

DEFENDANT'S EXHIBIT 138

THE OHIO OIL CO.

Lima, Ohio,
August 2nd, 1895

J. W. Van Dyke, Gen'l Manager,
The Solar Ref'n'g Co.,
Lima, Ohio.

Gentlemen:—

Replying to your telegram of today, will enclose you a copy of our record of the well in which you are anticipating introducing acid. The well is known as the No. 3 R. Crossley "fee," and has 5⅝ casing. We cannot tell the depth of the "oil bearing rock," as you term it, because the writer does not know of any such thing. Any kind of sand as far as can be judged after being "drilled up" may, or may not, produce oil; therefore, we never note anything but the point at which the wells make their show of oil gas or water.

Very truly yours,
C. F. Lufkin

DEFENDANT'S EXHIBIT 151

Report on Scale Formation in Wells. By Blaine B. Wescott. **Research Project Ch-17. Research Laboratory, Gulf Oil Companies, Mellon Institute, Pittsburgh, Pennsylvania.**

Contents

Scale Formulation in Wells, by Blaine B. Wescott.

Purpose.

The investigation of the formation of scale deposits in wells (Research Project Ch-17) was undertaken at the request of Mr. C. P. Dimit, production superintendent of the Gypsy Oil Company. The investigation applies particularly to wells in the Glenn Pool where the scale deposition has been more or less general in many of the wells. The purposes of the investigation were to determine the cause of the deposition, to find a method for its removal and to ascertain whether the formation of the scale could be prevented. The first two objectives have been accomplished; the third is still a matter for study at the present time.

Description of Samples.

The samples listed in Table 1 were submitted by Mr. Dimit in connection with this problem.

Table 1.

Description of Samples.

Sample No.	Description.
425	Scale from the outside of the 19th joint of tubing from Jennie Spocogee Well No. 5, in the north extension of the Glenn Pool in Section 17, Township 18 North, Range 12 East, Map No. 31.
426	Scale from the inside of the same joint of tubing described under No. 425.
427	Water from Lease Well J. Anderson 1, Glenn Pool, Section 9, Township 17, Range 12, 1-17-28. Pumping.
428	Water from Lease Well J. Anderson 2, Glenn Pool, Section 9, Township 17, Range 12, 1-20-28. Pumping.
429	Water from Lease Well A. Y. Barnes No. 2, S. E., N. E., N. W., Section 8, Township 17, Range 12, 1-19-28.
430	Water from Lease Well J. P. Rhodes No. 6, N. W., N. W., N. W., Section 21, Township 17, Range 12, 1-18-28.

The sample of tubing from the Jennie Spocogee Well No. 5 was very heavily scaled on the outside and more lightly scaled inside. The well ceased to produce about three years ago, apparently because of tubing trouble. The tubing could not be removed by the usual methods. Since the well was a small producer, removal of the tubing was delayed until November 29, 1927. It was necessary to pull the tubing until it parted and then fish it out by sections. In this case it was found that the tubing was scaled about uniformly for 420 feet from the bottom. Figures 1 and 2 were taken from the 19th joint of tubing from this well showing the extent of the scaling.

Water Analyses.

The analyses of the water samples are given in Table 2.

Defendant's Exhibit 151

Figure 1.

Scale deposit on the outside of the 19th joint of tubing from Jennie Spocogee Well No. 5, Glenn Pool. Scale was chipped off at the top to show the thickness of the deposit.

Figure 2.

Cross sectional view of scale deposits on the 19th joint of tubing from the Jennie Spocogee Well No. 5, Glenn Pool. showing scale deposits on both inside and outside of the pipe.

Table 2.

Analyses of Water Samples From Wells in Glenn Pool.

Sample No.	427	428	429	430
Well	J. Anderson No. 1	J. Anderson No.2	A. Y. Barnes No. 2	J. P. Rhodes No. 6
Constituent	Amount in grams per U. S. gallon.			
Total dissolved solids	7543.2	7370.7	7310.6	7899.0
Suspended matter	29.7	21.0	21.6	17.1
Calcium bicarbonate ($CaCO_3$)	6.2	11.2	12.8	24.0
Magnesium bicarbonate ($MgCO_3$)	nil	nil	nil	nil
Calcium sulfate ($CaSO_4$)	nil	nil	nil	nil
Magnesium sulfate ($MgSO_4$)	nil	nil	nil	nil
Sodium sulfate (Na_2SO_4)	7.3	6.4	7.3	5.7
Calcium chloride ($CaCl_2$)	803.0	772.0	753.0	775.0
Magnesium chloride ($MgCl_2$)	417.0	493.0	527.0	638.0
Strontium chloride ($SrCl_2$)	75.0	84.0	36.0	73.0
Sodium chloride ($NaCl$)	6230.0	6000.0	5970.0	6380.0
Iron and alumina (R_2O_3)	3.8	3.1	3.4	2.6
Silica (SiO_2)	0.9	1.0	1.1	0.7

The analyses showed the water to be a brine high in calcium bicarbonate, a constituent causing temporary hardness. The amounts of this substance present were high in all the samples excepting No. 427. It is probable that the other three samples were more nearly representative of the general conditions throughout the field than No. 427 containing the lesser amount of calcium bicarbonate. Large amounts of calcium bicarbonate are held in solution by means of the carbon dioxide present. A release of pressure

such as would occur when the water enters a well cavity would allow the carbon dioxide to escape and would be accompanied by the subsequent precipitation of calcium carbonate. There is no doubt that these facts explain the heavy scale deposition in the wells of this field.

Scale Analyses

The analyses of the samples of scale are given in Table 3.

Table 3.

Analyses of Samples of Scale From 19th Joint of Tubing From Jennie Spocogee Well No. 5.

Sample No.	425	426
Location	Scale from outside of tubing.	Scale from inside of tubing.
Oil	20.85%	1.19
Organic matter and water	2.52	0.95
Iron and aluminum oxides	3.01	5.52
Calcium carbonate	70.63	81.88
Magnesium carbonate	2.85	10.89

The composition of the scales substantiated the conclusion reached from the water analyses, namely, the scale deposition was caused by the release of pressure on a highly carbonated water.

Some previous work on scales from wells in the Glenn Pool indicated the presence of large amounts of strontium carbonate. For this reason special attention was given to the determination of strontium in both the waters and scales. The results of the strontium analyses in the water samples are given in Table 2. This work showed without doubt that the strontium in the water samples was present in the form of strontium chloride, a freely soluble salt, and therefore, the presence of this salt in no way affected the scale deposition and furthermore, any strontium present in the scale was due to occlusion of the salt by the scale.

Again, this conclusion was substantiated by the analyses of the scale samples for strontium which are given in Table 4.

Table 4.

Results of Analyses for Strontium in Samples of Scale from Jennie Spocogee Well No. 5.

Sample No.	425	426
Location	Scale from outside of tubing	Scale from inside of tubing
Strontium oxide	0.33%	0.12%
Corresponding percentage of strontium chloride	0.50	0.18

The insignificant amounts of strontium found undoubtedly point to occlusion of the chloride by the scale. The presence of such quantities of strontium is nothing unusual. The element is very closely related to calcium in its chemical properties and in ordinary analytical procedures is separated with and reported as part of the calcium content.

A complete analysis of the scale for chlorides, sulfates, etc., was not necessary since the problem was to find a solvent for the deposit. The amount of strontium reported in Table 4 appears as part of the calcium in Table 3. The results in Table 3 were not corrected for this constituent because, as just stated, a complete analysis was not necessary in order to determine a solvent for the scale, and because it has no bearing whatever on the purpose of this investigation as shown by the water analyses.

Removal of the Scale.

Since the scale was shown to consist mainly of calcium and magesium carbonates, the selection of a solvent was a simple matter. The scale was easily soluble in all mineral acids but the most suitable one was hydrochloric acid be-

cause the products of the reaction of the scale and hydrochloric acid are all soluble and offer no difficulty of removal. The use of an acid in removing the scale involves the loss of some of the metal of the tubing, casing and sucker rods by solution in the acid. The casing in the Glenn Pool field is old and probably more or less severely corroded in spots. The corrosion in areas subjected to scale deposition is probably slight as the scale forms a very efficient protective coating. There are available on the market, numerous patented materials called inhibitors which are used principally in the commercial pickling of iron and steel products to reduce the loss of metal by solution in the acid. Some of these materials are very efficient in their action in dilute acids. Among the most successful of the inhibitors are a series of materials called Rodines, manufactured by the American Chemical Paint Company, of Ambler, Pa. Experiments were made with the two Rodines made by this company which were most nearly suited for the protection of the ferrous materials in the wells in the presence of concentrated hydrochloric acid, namely, Rodine No. 2 and Rodine No. 106. Both Rodines are patented products so that accurate information regarding their composition is not available. Rodine No. 2 is a liquid, the base of which is waste sulfite liquor from the paper industry with additions of certain anthracene compounds. The Rodine No. 106 is a powdered material with thiourea as its base. Half sections of tubing about one-half inch in width were cut from the sample of the 19th joint of tubing from the Jennie Spocogee No. 5 well. The sections were pickled free of rust and scale, washed, dried and weighed. They were then immersed in concentrated hydrochloric acid with varying percentages of the two inhibitors. After remaining in contact with the acid for at least 48 hours at room temperature and 6 hours at 125° F. the pieces were washed, dried and reweighed. The results are given in Table 5.

Table 5.

Effect of Inhibitors on the Action of Concentrated Hydrochloric Acid on Steel Pipe.

Temperature of Test F°	*Hours Immersed*	*Inhibitor*	*Amount of Inhibitor Used*	*Per Cent Loss in Weight*	*Approximate Loss in Weight in Grams Per Sq. Inch of Surface Per Hour Immersed*
125°	7	None	——	57.2	0.638
125°	7	Rodine No. 2	2%	3.3	0.037
Room	72	None	——	86.4	0.094
Room	72	Rodine No. 2	2%	12.5	0.0136
Room	48	Rodine No. 2	3%	1.4	0.0023
Room	48	Rodine No. 2	4%	0.7	0.0011
Room	48	Rodine No. 106	1 lb./10 gal. of acid	5.6	0.0092
Room	48	Rodine No. 106	1 lb./5 gal. of acid	3.3	0.0054
Room	48	Rodine No. 106	1 lb./2½ gal. of acid	1.4	0.0022

The losses in weight in grams per square inch of surface exposed per hour (figures in the last column of the table), afford a direct comparison of the protection afforded to the metal in the respective tests. The greatest protection was given by the use of 4 per cent of Rodine No. 2 by volume of acid. This protection was just twice as great as that given by the use of Rodine No. 106 in the proportion of 1 pound to every 2½ gallons of acid used. There is no doubt that for the purpose at hand that Rodine No. 2 will prove most suitable. It not only affords greater protection but is much easier to handle since it is a liquid.

The results given in Table 5 indicate that perfect protection to the steel could most probably be insured by the use of sufficient Rodine. It would not be economical to do that however. Furthermore, the results in the table are considerably higher than those that would actually be met with in practice because of the dilution of the acid by fluid

material in the wells. The losses represented by the use of 4% of Rodine No. 2 were nearly negligible.

Theory of Inhibitors.

The commercial use of inhibitors for the protection of metals in acid solutions is not new. A very great number of substances have been studied for their inhibitive value; some have been good, others worthless. There has been no definite relation indicated between chemical properties and inhibitory value. The mechanism of the inhibitive action is very little understood. Some inhibitors are colloidal in nature and it has been noticed that the over-voltages at anode and cathode in acid is increased proportionally to the colloid concentration. Some substances, such as formaldehyde and quinoline ethiodide exert powerful inhibitory action when only very small amounts are present, suggesting that the effect is catalytic in nature. It has also been suggested that the inhibitor forms some sort of film over the cathode which acts to prevent the ready evolution of hydrogen. The most recent explanation advanced for the action is as follows:

Iron immersed in acid goes into solution at the anode areas, forming iron ions in solution and depositing an equivalent amount of hydrogen ions at the cathodic areas. These cathodic areas are assumed to occur principally in the grain boundaries of the crystals in steel or at the interface of slag and iron in wrought iron. Most inhibitors are either organic bases or positively charged colloids, and when these are present, they travel to the cathode areas with the hydrogen. When the positively charged heavy particles of the inhibitor are discharged at the cathodes, they cannot escape by gaseous evolution, and accordingly are absorbed on the surface building up a protective layer.

Estimated Cost of Scale Removal

The cost of Rodine No. 2 is as follows:

Table 6.

Cost of Rodine No. 2.

In 10 gallon drums....................	$2.50 per gallon
In 52 gallon drums....................	3.25 per gallon
In lots of 10 or more 52 gallon drums per year...........	3.00 per gallon

Rodine No. 106 varies in cost between $0.35 and $0.40 per pound depending upon the amount purchased.

The prices for commercial hydrochloric (muriatic) acid in less than carload lots in carboys F. O. F. Pittsburgh are as follows:

Table 7.

Cost of Hydrochloric Acid.

No. of carboys	Cost per 100 lb.	Cost per carboy	Cost per gallon
1 to 4	$1.95	$2.24	$0.224
5 to 9	1.85	2.13	0.213
10 to 20	1.75	2.01	0.201
20 and over	1.65	1.90	0.190

Note: 1 carboy=115 pounds=10 gallons.

Assuming the purchase of hydrochloric acid in lots of 20 or more carboys and the purchase of Rodine No. 2 in 52 gallon drums, the total costs for materials per gallon of acid used for a 4% solution of Rodine would be $0.32. The actual cost in the field would be somewhat greater since the acid prices given were F. O. B. Pittsburgh and the Rodine prices F. O. B. Ambler, Pa.

The estimate given below as to the amount of acid required for one well was furnished by Mr. Sommers, of the Geological Department upon the following assumptions,

which he considered to be average for the field as judged from the available information:

1. $6\frac{5}{8}$ inch casing string to within 300 feet of the bottom of the hole.
2. 275 feet of about $6\frac{1}{2}$ inch open hole below tubing.
3. 25 feet of about 12 inch open hole resulting from shooting with 40 quarts of nitroglycerine.
4. For filling $6\frac{5}{8}$ inch casing it requires about 1/25 barrel per foot.
5. 1 barrel=6.2 (5.6) cubic feet=42 gallons.

Assuming the casing is to be filled for 300 feet the acid required would be approximately 1092 gallons. This would require 44 gallons of Rodine for a 4% solution. The total material cost would then be $350. This estimate, as can be readily seen, is based upon very indefinite and general information and a much more accurate figure could be arrived at by taking data for a definite trial well.

Method for Scale Removal.

In the use of hydrochloric acid and Rodine No. 2 in dissolving the scale from the casing and tubing in the wells, the proper amount of Rodine should be added to each carboy of acid and the two liquids well mixed by shaking the carboy before the acid is poured into the well. For a 4% solution the amount of Rodine No. 2 required per carboy would be roughly $3\frac{1}{2}$ pints. The estimated quantity of mixed acid would then be poured into the well both down the tubing and down the casing. It is not possible to estimate the time required since that would depend almost entirely upon the surface of scale exposed to the acid. The acid could be allowed to remain in the well for several days without danger to the tubing and casing. When solution of the scale is judged to be complete the well should be well washed with water and the spent acid and washings discarded.

The amount of acid required to dissolve any given amount of scale could be readily calculated but the figure

would have but little value since the thickness and height of the deposits would be unknown unless the tubing were withdrawn, in which case the scale could be knocked off easily and at a fraction of the cost required to dissolve off.

Great care must be exercised in handling the acid in order to avoid burns and destruction of clothing.

Prevention of Scale Formation.

The necessity for removal of the scale in wells suggests the possibility of preventing its formation. It is very probable that the formation of scale could be materially decreased or prevented entirely by the use of sufficient amounts of sodium bicarbonate. The addition of sodium bicarbonate to waters containing high amounts of calcium bicarbonate prevents the deposition of calcium carbonate even at comparatively high temperatures. The action is the result of the introduction of the common bicarbonate ion into the solution which prevents the reaction resulting in the precipitation of calcium carbonate from going to completion.

The feasibility of such a procedure is doubtful, however, because of the probable expense and the difficulty in properly mixing the water and chemical. Constant treatment of large amounts of water would be necessary. If the liquid between the tubing and casing did not change rapidly the treatment would be much less expensive. The rate of change of fluid between casing and tubing could be determined by introduction of a suitable dye between the tubing and casing and noting the time before its appearance from the tubing. Such a test would furnish the necessary information for determining whether water treatment could be economically used. Periodical removal of the scale either with acid or by removal and cleaning of the tubing would probably involve much less expense.

The suggestion was advanced by Mr. Weaver, of the Geological Department, that since the wells in this field are pumped by vacuum lift, there is a possibility of air leakage

into the producing sand through some well. Such a leak, if of any magnitude, would cause the introduction of large amounts of carbon dioxide into the sand and might result in the solution of large amounts of calcium bicarbonate which would later be precipitated in some other well upon release of pressure, with the accompanying liberation of the carbon dioxide. Such a possibility is worthy of investigation. However, it seems more likely that the carbon dioxide either originally existed in the field or is being produced by oxidation processes occurring in the ground. The present report is primarily concerned with the means for removal of the scale, but the fundamental source of the carbon dioxide, responsible for the scale, is a problem to which attention will be given at a later date. It is certainly of academic interest and may have an important practical bearing.

Conclusions.

The following conclusions were reached in this investigation:

1. The scale deposited upon the tubing and casing in the wells of Glenn Pool consists principally of the carbonates of calcium and magnesium.
2. The deposition of the scale is the result of the high temporary hardness content (calcium and magnesium bicarbonates) of the oil field water in that area. The passage of water from the sand to the well is accompanied by a release of pressure allowing the escape of carbon dioxide which causes the deposition of calcium and magnesium carbonates.
3. The only economically available solvent for the scale is hydrochloric (muriatic) acid.
4. Hydrochloric acid treated with a sufficient amount of a suitable inhibitor may be used without fear of damage to sucker rods, tubing, casing or other ferrous materials in the well.
5. Rodine No. 2 (or other Rodines having like inhibitive value) used in the proportion of 3% to 5% by volume of

acid affords ample protection to the ferrous materials in the wells.

6. It is doubtful whether the scale could economically be prevented from forming. Preventive measures would involve the continual treatment of the water in the wells with sodium bicarbonate.
7. The feasibility of the water treatment method would depend upon the outcome of tests made to determine the rate of change of water in the wells between tubing and casing. Such tests could be rather easily carried out by the introduction of a suitable dye (fluorescein) into the well outside of the tubing and noting the time and fluid production of the well between the time of introduction and time of its appearance.
8. The release of pressure probably occurs at the surface of the sand in the well cavity, in which case it is reasonable to suppose deposition of more or less of the scale on the surface of the sand. Therefore, the trial would be well worth the expense for its possible value in increasing the production of the well entirely aside from the object of removing the scale from the pipe.

Recommendation.

I recommend that the removal of the scale by use of hydrochloric acid and 4% of Rodine No. 2 or other inhibitor of equal effectiveness be tried in one well of the Glenn Pool.

DEFENDANT'S EXHIBIT 152

Production Department, Engineering Report.

Tulsa, Okla., February 1, 1929.

Subject: Gyp Treatment at Glenn Pool.
Assignment No. 38. Written by F. W. Karl.
Consulting Eng., D. L. Trax.
Production Eng., R. L. Wright.

William Berryhill No. 8 was selected for the experiments on scale removal as outlined in our previous reports of August 24th, and September 14th, 1928, the well having been off production because of "gyped" tubing in March, July, September and November, 1928. A device was constructed for lubricating the acid and inhibitor into the well between the tubing and casing without releasing the vacuum.

On November 12th, nine carboys of hydrochloric acid, approximately 1,000 pounds, and the necessary rodine to give a four per cent by volume mixture, were lubricated into the casing of the well. The following day the well failed to pump and the tubing was pulled. The Penrod and Thompson barrel was removed and a common barrel substituted. One and one-half carboys of acid and the proper amount of inhibitor were poured down the tubing and Hough liner barrel run in on the rods. Considerable difficulty was experienced in getting the barrel down through the tubing, it being necessary to lift and drop the rods several times to force the barrel through the deposits on the tubing. After the barrel was seated, one and one-half carboys of acid and inhibitors were added partly to fill the tubing. The well was allowed to stand one day and then pumped. Samples of the fluid showed no free water. This seemed to indicate that insufficient acid had been used and an additional five carboys of acid were run in between tubing and casing. The well was allowed to stand a day and then pumped. No free water was produced but on extrac-

tion of the fluid with distilled water a distinct acid reaction was obtained.

Since the acid treatment was applied the well has pumped satisfactorily but the production has not been increased. No pulling jobs have been necessary for "gyp" trouble but the time has been too short to draw any definite conclusions as to the effectiveness of the treatment.

FWK:HG F. W. Karl.

DEFENDANT'S EXHIBIT 153

Same as Plaintiff's Exhibit 153. (See pages 1664 to 1704.)

DEFENDANT'S EXHIBIT 287

INDEX FOR CORROSION EXPERIMENTS

Sheet #	Curve #	Test No.	Page # in Data Book	Page # in Calc. Book	Date of Run
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	2	E	127	81	6-10-41
	3	E	49	36	3- 5-41
	4	A-B	91	58	4- 8-41
	5	A-B	35	30	2-24-41
	6	C-D	45	34	3- 3-41
II	1	E	84	54	3-31-41
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	6	O-P	124–26	111	5-12-41
	7	M-N	117	112	5- 5-41
	8	G	116	113	6- 1-41
VI	1	S	129	84	6-13-41
	2	V	134	86	6-23-41
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	5	E	127	81	6-10-41
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	2	R	133	89	6-20-41
	3	E	131	88	6-17-41
	4	V	139	92	6-30-41
	5	S	136	90	6-25-41
	6	AA	141	93	7- 7-41

DEFENDANT'S EXHIBIT 300

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
$100 + 72$
1 barrel 20% acid HCl $\underline{\text{42 Gallons}}$

$42. \times 3.78 \times 1100 \times 20\% = 34{,}920$ gms. HCl

$$\frac{34{,}920}{72} = 486 \times 100 = 48{,}600$$

$$\frac{48{,}600}{454} = \frac{107\#}{—} \quad CaCO_3 — 298 = 3.0$$

$$\underline{107\#\ \text{C.P. } CaCO_3}$$

$$3)\ \underline{48{,}600}$$
$$16{,}200 \text{ C.C.}$$

$16.2 \times .035 = .567$ cu. ft. $CaCO_3$ C. P.

DEFENDANT'S EXHIBIT 301

THE PURE OIL COMPANY

Chicago, December 1st, 1932.

The Dow Chemical Company,
Midland, Michigan.

Attention Mr. Dow.

Gentlemen:

Absence from the office of the writer and others with whom it was necessary to discuss the matter, has delayed reply to your letter of November 5th relating to the patent situation involved in the acid treating process which we discussed fully on the occasion of our recent conferences in your office.

In your letter you have merely reiterated the contentions made by you and your representatives to us, without giving weight or what we feel is due consideration to the representations made by us to you. We have attempted in our various conversations to give you what we think is the picture and history covering this entire transaction. You have been given another picture by employees of your company with which we do not agree in any particular. Certain statements were made to us about conversations had between our Messrs. Humphrey and Thomas, and your Messrs. Grebe and Sanford, which we felt were erroneous, and in order to clear up the matter and establish a better understanding of what actually transpired, we suggested and you agreed that we bring Messrs. Thomas and Humphrey to Midland and have them and the two gentlemen from your organization give us and you their version of what was said by each, and when. We had Mr. Humphrey come from Chicago and Mr. Thomas from Saginaw, and we presented them to you, but were informed by your attorney that for certain reasons it was not considered advisable at that time to proceed with that phase of the investigation.

We stated to you then and we reiterate now, that it is our firm conviction that if the idea of treating oil wells with acid, or any process used in connection therewith, is patentable, that The Pure Oil Company, being the inventor, is entitled to any such patent. So far as Dow is concerned, the only way it ever became involved with us in this picture was as a source of supply of the acid we required in making the original experiment and further supplying acid to us at a price thereafter. The first conversation ever had between any representative of Dow and any representative of Pure, concerning this matter, was when our Mr. Thomas called at your office in Saginaw for the purpose of determining whether or not Dow could or would supply us with acid to make this test. The question of an inhibitor was raised at this first discussion and your Mr. Grebe advised Mr. Thomas that an inhibitor could be supplied by Dow. It was our information that at times in its regular operations it was necessary for Dow to make a considerable amount of Hydrochloric Acid above its current requirements, and that at such times it was in a sense a waste product. Your company was glad to furnish us with the acid free of cost for the initial test, because if it proved to be successful, as we had every reason to believe it would, it would afford a ready market for this product. This is somewhat in line with your own statement to the writer at your home, when you said that when Dow first went into the matter it was with the idea of creating a market for the acid, and that later, in order to restrict competition and protect this market, you felt called upon to apply for patent.

Your company did deliver the first acid to the well location, but our own employees did the actual work of introducing the acid into the well. Your company asked permission to have a man present on the well, which was granted, and your representative who was permitted to witness the test was cautioned by our Mr. Humphrey to treat this matter in the strictest confidence. This request was made both of Mr. Sanford and Mr. Grebe. This was done under specific instructions from the management of this company.

When our Mr. Thomas called at your office in Midland for the purpose of ascertaining whether or not you could or would furnish the acid for this work, he was referred to your Mr. Grebe. After Mr. Thomas had explained the purpose of his call, Mr. Grebe advised that the acid would be supplied but that he doubted whether it would work, since Dow had made some kind of an experiment on one of its brine wells producing from the Marshall sand and the experiment had been a failure. I mention this in connection with your statements that it was necessary for Dow representatives to sell this idea to Pure's representatives. You have stressed this point at different times and in your letter, even in the face of our statements to you that this was not the fact, and it now becomes my duty to again advise you that this matter was worked out in our own laboratory before Dow ever heard anything about it from us, and the only reason that Dow ever came into the picture, so far as we are concerned, was, as before stated, because they were manufacturing a product required by us in this work and were conveniently located to our operations. This was one of the points we had hoped to clear up in your mind when we brought Messrs. Thomas and Humphrey to your office in Midland.

You have further stressed the fact that Pure did not question Dow's claim to invention of the use of an inhibited acid in connection with this work, until long after the filing of application and issuance of patent to Dow. The fact is that we called on you very shortly after the issuance and publication of the patent to you. This was our first information that Dow was interfering with what we claim is our invention, to the point of seeking a patent covering it, and frankly, it was quite a surprise to us, knowing as we did what part Dow played in this undertaking. As to the use of an inhibited acid, we went into this quite fully with you in our various conversations. The inhibitor plays no part whatever in the treatment of the oil producing formation, its only function being to protect the equipment at or in the hole, or used in transporting acid to location. The

use of an inhibitor in an acid to protect a metallic substance against attack from the acid itself, is admittedly not new. This is the only function of the inhibitor in acid for oil well treatment. As we advised you, in our original study of this matter this factor had been considered and given full weight before anyone from The Pure Oil Company ever approached Dow in connection with the matter.

In your letter you mention a number of significant factors, but the writer cannot escape the conclusion that the most significant factor in the whole picture is this one fact: For the sake of illustrating this point, without admitting but specifically denying the correctness of the statements and claims made by Dow, it is quite significant that with oil wells producing from lime formations in Michigan for several years, almost within sight of Dow's main plant and from properties on which Dow has brine wells producing, so far as the writer knows Dow never at any time made any experiment on any oil producing well or suggested any such experiment to anyone else, nor did it file any application for patent until after it had been approached by Pure and Pure had made the tests, determined the practicability of acid treatment of lime wells, and made it operative and a commercial success.

You mention the fact that Dow has established a service of wide scope, offering not only acid treatment but a variety of well treatments of interest and value to the oil producer. For the moment we are not interested in the well service other than acid treatment, which is the subject matter of this communication.

Based on past relations we have every confidence in the fairness and integrity of your organization and feel that the present controversy is due to misinformation in connection with the origin of the acid treatment process as between our two companies, and that when this is cleared up there will be no trouble in arriving at a fair and equitable settlement of this dispute, however, we cannot agree that the suggestion contained in your letter of November 5th is a fair basis of negotiating an adjustment.

Yours very truly,

CP-F. C. Plummer.

DEFENDANT'S EXHIBIT 302

December 8, 1932

MEMORANDUM OF CONVERSATION WITH ROSS T. SANFORD

Subject:—Negotiations with Representatives of Pure Oil Company Leading up to First Treatment of Oil Well with Inhibited Acid.

Mr. Sanford recalls meeting Mr. Thomas of the Pure Oil Company in the Dow Main Office one day shortly after January 1, 1932, and taking him over to Mr. Grebe's office, at which time the subject of treating oil wells with acid, particularly inhibited acid, was first discussed. He is uncertain as to the presence of Mr. Humphrey at the time, but seems to recall that there was another Pure Oil man there.

As regards the ensuing conversation in Mr. Grebe's office, Sanford's recollection is vague, but it is his opinion that Pure Oil Company representatives had been experimenting with the use of acid to dissolve oil rock and had come here to consult with Dow Company men to get their recommendations as to the best procedure. He recalls that the Pure Oil representatives urged the possibility of a new market for HCl in well treating. Sanford does not recall clearly how the question of the use of inhibitors in the acid came up, but he does recall definitely that he recommended the use of chromate, which was the first material recommended during the conversation, and that Grebe later recommended arsenic as being better than chromate. He also recalls discussion as to the effect of the strength of the acid and that Grebe brought out a curve sheet showing that 15% HCl was about the best strength and that above that the amount of corrosion increased rapidly.

Sanford also recalls a later meeting with Humphrey in the field in which he sketched out this curve on the back

of an envelope and discussed the matter with Humphrey. Previously, the Pure Oil men had wanted to use full strength acid.

The treatment of the Fox Well No. 5 (or 6) was arranged when the Pure Oil representative, probably Mr. Humphrey, called up on February 10, 1932. Sanford called up Grebe to ask permission for Quinlan to take charge of the treatment of the well. He then called Quinlan to give the latter instructions for making up the acid, which Quinlan did. The next day, February 11, Sanford went out to the well along with Quinlan and the acid truck and was present when the first batch of acid was put into the well. He states that Quinlan measured the acid in the tank wagon and held the hose when the acid was run into the well. Sanford does not remember who were the representatives of the Pure Oil Company on the job at that time. On the day after the first treatment with acid, Sanford went back and got a sample of the spent acid which had been pumped out of the well and found that it was still slightly acid. He recalls that three later treatments were made using acid from the original tank wagon load, making four treatments in all from the 500 gallons of acid in the tank wagon. The treatments after the first were made by the Pure Oil Company's men. Previous to the treatment of the first well, Sanford recalls discussing with the Pure Oil Company men the effect of acid on oil-saturated Dundee rock and that they told him that acid had been tried and found to dissolve the rock, but were afraid that if acid was put into a well it would cause damage to it. He also recalls, about this time, talking with Mr. Griswold over the probable action of acid on oil-soaked rock in which Mr. Griswold doubted that the acid would attack the rock.

E. C. Burdick.

I have read the above memorandum and find it substantially correct according to the best of my knowledge and belief.

Ross T. Sanford.

January 5. 1933.

DEFENDANT'S EXHIBIT 303

December 8, 1932

MEMORANDUM OF CONVERSATION WITH JOHN J. GREBE

Subject:---Negotiations with Representatives of Pure Oil Company Leading up to First Treatment of Oil Well with Inhibited Acid.

The exact date of the first meeting between Messrs. Grebe and Sanford and Messrs. Thomas and Humphrey of the Pure Oil Company cannot be definitely established. It was, however, shortly after January 1, 1932. Grebe recalls the circumstances clearly. Mr. Sanford brought Messrs. Thomas and Humphrey into Mr. Grebe's office on that occasion. Grebe knew Thomas from several previous meetings, since Thomas, who was a geologist for the Pure Oil Company, had been in frequent contact with The Dow Chemical Company during the development of the local oil field, had consulted with regard to well drilling data and had had brine analyses run at the Main Laboratory. This was the first meeting with Humphrey, however, who was introduced to Grebe by Mr. Thomas.

Grebe states that Humphrey opened the conversation directly, stating that he had two problems to talk over which he thought the Dow Company might be of help in solving and in connection with which he wished to ask for recommendations as to the best way of attacking the problems. These problems were (1) treating oil wells with acid and (2) dissolving out paraffin with solvent.

Humphrey said that he had been trying to convince his superior, Mr. Carr, that acid would act upon oil-soaked rock, but that Carr refused to believe it. Humphrey had made some laboratory tests with samples of oil rock from the Dundee structure in which he had shown that hydrochloric acid would dissolve the rock.

Grebe told them that the Dow Company had used hydrochloric acid for treatment of brine wells and that he believed it would work for oil wells and could be made safe to use without damage to the well structure by adding an inhibitor to it. On the matter of inhibitors, Sanford made the first suggestion, stating that chromate would act and thereafter Grebe said that arsenic would be better and that it had been used on some of our own brine well treating jobs. Grebe states that he described in some detail to Thomas and Humphrey the work that we had done on brine wells in attempts to increase brine production and also for brine disposal through pumping back into old wells.

Grebe states that neither Humphrey nor Thomas showed familiarity with inhibited acids. Grebe explained to them how inhibitors worked. Grebe states that he remembers very clearly, after he had made this explanation, that Humphrey was much impressed and made the statement that, if inhibitors would work as Grebe stated, he (Humphrey) was sure that he could go back and convince Carr to let him treat a well with acid. Grebe is quite positive as regards this incident during the interview.

Following the interview of Grebe and Sanford with Humphrey and Thomas, it appears that the latter applied to their superiors for permission to treat a well with acid, but it was not until February 10, 1932, that they telephoned in that they had a well ready for treatment, this being the Fox No. 5 (or 6) well which was treated by the Dow Company on February 11, 1932.

Grebe recalls another conversation with Humphrey several months later, probably in May or June, 1932, in which some reference was made to the patent aspects of well treatment. Humphrey told him that the Pure Oil Company's Patent Attorney had made a search and found that the use of acid had been patented about forty years earlier and used in Ohio and California. Humphrey stated, in a general way, that his Company was well set on protection for methods of getting acid into the well. He then stated, further, to Grebe, as the latter clearly remembers,

that all the Dow Company had in connection with the treatment was the use of inhibitors. Grebe states that he reported this conversation to Mr. Griswold immediately afterward and urged that our patent application should be filed promptly.

E. C. Burdick.

I have read the above memorandum and find it substantially correct according to the best of my knowledge and belief.

John J. Grebe.

December 9, 1932.

DEFENDANT'S EXHIBIT 304

Pencil note—"Copy of this draft sent to Nelson at Wash. for use in connection with search. E. C. B."

TREATMENT OF DEEP WELLS

John J. Grebe
Disclosure No. 1173
Case No. 850-G
June 7, 1932

The present invention relates in general to the treatment of deep wells to increase the delivery of fluid mineral products therefrom and relates specifically to wells deriving such flow from an acid-soluble rock formation such as limestone, dolomite, magnesite, or other basic stratum, or

from any natural formation which may be dissolved wholly or in part by an acid, such as sandstone with a lime binder. It also relates to loosening scale and/or incrustations, such as salt scale, paraffin wax, etc., from the bore of the well by attack of an acid upon the rock to which such scale adheres.

After completion of a drilled hole into a mineral-bearing stratum for the purpose of obtaining oil, gas, water, brine, or other fluid mineral product, the flow thereof is not always as great as desired and "shooting" the well with nitroglycerine or other explosive is often resorted to in the hope of increasing the rate of flow. The explosion is thought to increase the flow area through which the fluid products may pass and enter the well, either by enlarging the bore thereof and/or by creating fissures in the surrounding rock. Such shooting of a well is a hazardous procedure, particularly when a heavy explosive charge is used, and serious damage may result, e.g., the rupture of the casing, the loss of the hole, together in some instances with tools later employed to clean it out. Other methods are accordingly desirable which will reduce such hazards and the present invention provides a method which has been proved successful in increasing the flow from wells of the character referred to.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the steps hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail several modes of carrying out the invention, such disclosed modes illustrating, however, but several of various ways in which the principle of the invention may be used.

I will now describe my invention as applied to the treatment of an oil well in which the flow of oil is from a calcareous or limestone formation, or in which such a formation is adjacent to the stratum from which the oil is delivered to the bore of the well.

A quantity of an acid solution is introduced into the bottom of the well, which attacks or dissolves the mineral-

bearing rock formation at the base of the bore, accompanied by the evolution of carbon dioxide gas if, as is often the case, the rock is a calcareous formation. For the purpose, a strong mineral acid, such as hydrochloric acid, is best adapted. The acid solution is preferably of a strength such that the soluble salts formed by its action on the rock constituents will remain dissolved therein. The quantity of acid to be used in any case may vary greatly with the type and thickness of rock formation, size of bore, and other factors, but may be calculated as sufficient to fill the bore of the well to a height corresponding approximately to the thickness of the stratum to be acted upon. After the action of the acid has practically ceased, the spent solution containing the dissolved salts formed may be pumped or bailed out, after which the regular pumping of the well may be resumed. It has been found that the successful carrying out of the treatment greatly increases the output of the well.

If the well has not been previously shot with explosive, it may be advantageous to shoot same prior to applying the acid treatment. In such case, however, it will suffice to use a much smaller charge of explosive than otherwise customarily employed when the effect of the charge alone is to be depended upon to increase output. Such smaller charge may be used with greatly decreased hazard to the bore of the well or to casing or drive pipe.

Assuming, then, that the pump tubing and rods are in place, the rods may be withdrawn and the acid poured down the tube, followed by a quantity of oil to force the acid charge out of the bottom of the tube from which it will emerge into the bore and rise therein. A simple calculation based upon the known diameter of the hole and the known thickness and levels of the stratum of the rock to be attacked will enable the determination of a suitable volume for the charge of acid to be used, and the character of the rock and the solubility of the mineral salts resulting from the treatment will enable the determination of the strength of the acid such that the salts formed may be re-

tained in water solution and be removable with the water. After the evolution of carbon dioxide gas has substantially ceased, indicating that the acid has become exhausted, the pump rods may be relowered into the pump tube and the water solution of soluble salts pumped out. By continued pumping oil will be delivered as before, but usually at an increased rate. If the increase is not great enough at first, the treatment may be repeated, as already explained.

In order to prevent, or at least to minimize, the corrosive action of the acid on the pump tube or well casing it is advisable to add to the acid an inhibiting agent to reduce the rate of chemical action of the acid upon metallic surfaces in contact therewith. By so doing the well can be treated without removing the casing. As such agent I may select any of the known inhibitors which are used for acid pickling baths and the like. Examples of such inhibitors are arsenic compounds, cyanides, organic nitrogen bases such as pyridine, quinoline, acridine and derivatives thereof, as well as various by-products of industrial processes, such as sludge acid from oil refining and residues from acid sulphite paper manufacture, etc.

Alternative methods of procedure involve the application of additional pressure to the bore of the well after the charge of acid has been placed therein by admitting oil or water thereto, so as to increase the hydrostatic head on the acid, thereby forcing it into the pores or fissures of the rock and carrying its action deeper into the rock structure. A similar result may be attained in some cases if the hole is capped off after introducing the acid, so that the resulting increase in gas pressure due to liberation of carbon dioxide may be employed to increase the pressure upon the acid in the well and force it into the rock. Mechanical pressure may also be employed, as by use of a pump, to force acid into the rock by gas or liquid pressure.

Where working with a well in which the flow is from a siliceous rock not readily attackable by a mineral acid, but which stratum has a limestone or calcareous formation in juxtaposition thereto, acid treatment as herein described

may still be effective to improve the output of the well. The action of the acid on such juxtaposed stratum may result in opening up flow channels therethrough leading from the siliceous pay-rock stratum into the bore of the well. This procedure may be indicated for brine wells deriving their flow from a sandstone formation overlaid by, or in contact with, a calcareous stratum. If the pay-rock is siliceous and has a lime or magnesia binder, a similar procedure may dissolve out the binder and open up flow lines to the well.

In the practical use of my method in the central Michigan oil field where the oil is derived from a calcareous rock stratum, I have employed successfully commercial hydrochloric acid of 10° to 12° Be′ strength to which has been added a minor percentage of arsenic. The arsenic may be added as arsenic trioxide, As_2O_3, or arsenic acid, H_3AsO_4, or as any soluble arsenic compound, such as an alkali metal arsenite or arsenate. The amount added may be varied considerably, but from 1 to 5 per cent of the arsenic compound, based upon the weight of the solution, will usually be satisfactory for the purpose. Such procedure has permitted the introduction of the acid into the iron pump tube without involving consequential attack upon the iron. In a given instance, employing 4500 pounds of hydrochloric acid of 15 per cent strength, having a calculated content of 675 pounds HCl, 2 gallons of arsenic acid solution containing by calculation approximately 21 pounds As_2O_5 were used and good results obtained. It should be noted that when employing hydrochloric acid introduced through iron piping or by the use of iron equipment, the strength of the acid will advisedly be not over 15 per cent to 18 per cent HCl, since the rate of attack of hydrochloric acid upon iron, even with arsenic present, increases rapidly above 15 per cent strength, whereas below that strength, the rate of attack is low. As regards the action of the acid to attack and dissolve the rock formation, any strength of acid may be used which is effective for the purpose.

Hydrochloric acid will usually be preferred for use with my method, inasmuch as the calcium and magnesium salts, which are principally formed by the action of the acid on the rock, are readily soluble in water and are removed with the spent acid solution when the latter is withdrawn from the well. Nitric acid is also suitable from the standpoint of solubility of its salts, but the cost would be greater. Other mineral acids, such as sulphuric acid or phosphoric acid, may be used in some cases, but less desirably owing to the insolubility of the calcium salts of these acids.

The method described has been employed for the treatment of oil wells resulting in an increase of output amounting to as much as from 75 to 200 per cent, and in some cases wells which had ceased to flow have been brought back with a resumption of regular flow. The invention, however, may be applied equally well to increase the flow from gas wells, brine or deep water wells in cases where the mineral or water bearing stratum, or the immediately adjacent strata, are of a nature to be acted upon and dissolved by an acid solution.

1. In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing a mineral acid solution into the mineral bearing rock strata adjacent to the bore of the well.

2. In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing a hydrochloric acid solution into the mineral bearing rock strata adjacent to the bore of the well.

3. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises introducing a mineral acid solution into the bore of such well, permitting the solution to act upon the rock formation in contact therewith and withdrawing the spent acid.

4. The method of increasing the output of a well for

producing a fluid mineral product such as oil, gas or brine, which comprises introducing a mineral acid solution into the bore of such well, permitting the solution to act upon the rock formation in contact therewith, while applying pressure upon the solution, and withdrawing the spent acid.

5. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises pouring a mineral acid solution into the well casing, then closing the casing to prevent escape of gas, permitting the acid to act upon the rock formation at the base of the well under pressure due to the gas generated thereby and withdrawing the spent acid.

6. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises introducing a hydrochloric acid solution into the bore of such well, permitting the solution to act upon the rock formation in contact therewith and withdrawing the spent acid.

7. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises introducing a hydrochloric acid solution into the bore of such well, permitting the solution to act upon the rock formation in contact therewith, while applying pressure upon the solution, and withdrawing the spent acid.

8. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises pouring a hydrochloric acid solution into the well casing, then closing the casing to prevent escape of gas, permitting the acid to act upon the rock formation at the base of the well under pressure due to the gas generated thereby and withdrawing the spent acid.

9. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises pouring a hydrochloric acid solution containing a corrosion inhibitor into the metallic well casing, or tubing, then closing the casing to prevent escape of gas, permitting the acid to act upon the rock formation at the

base of the well under pressure due to the gas generated thereby and withdrawing the spent acid.

10. The method of increasing the output of a well for producing a fluid mineral product such as oil, gas or brine, which comprises pouring a hydrochloric acid solution containing a relatively small amount of an arsenic compound into the metallic well casing, then closing the casing to prevent escape of gas, permitting the acid to act upon the rock formation at the base of the well under pressure due to the gas generated thereby and withdrawing the spent acid.

11. The method of increasing the flow of oil in an oil well to which the oil flows through or in proximity to a stratum of calcareous rock which comprises introducing a mineral acid solution into the bore of such well, wherein such acid acts upon the calcareous rock to disintegrate and dissolve the same.

12. The method of increasing the flow of oil in an oil well to which the oil flows through or in proximity to a stratum of calcareous rock which comprises introducing a hydrochloric acid solution into the bore of such well, wherein such acid acts upon the calcareous rock to disintegrate and dissolve the same.

13. The method of increasing the flow of oil in an oil well to which the oil flows through or in proximity to a stratum of calcareous rock which comprises introducing hydrochloric acid containing a corrosion inhibitor into the bore of such well, wherein such acid acts upon the calcareous rock to disintegrate and dissolve the same.

14. The method of increasing the flow of oil in an oil well to which the oil flows through or in proximity to a stratum of calcareous rock which comprises introducing a 10 to 15 per cent hydrochloric acid solution containing a relatively small amount of an arsenic compound into the bore of such well, wherein such acid acts upon the calcareous rock to disintegrate and dissolve the same.

DEFENDANT'S EXHIBIT 312

DEPARTMENT OF COMMERCE
United States Patent Office

To all persons to whom these presents shall come, Greeting:
This Is To Certify that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of the

Letters Patent of
John J. Grebe and
Ross T. Sanford, assignors to

The Dow Chemical Company,
Number 1,877,504, Granted September 13, 1932,
for
Improvement in Treatment of Deep Wells.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this fifth day of July, in the year of our Lord one thousand nine hundred and thirty-nine and of the Independence of the United States of America the one hundred and sixty-fourth.

(Seal) Conway P. Coe,
Commissioner of Patents.

Attest:
D. E. Wilson,
Chief of Division.

PATENT No. 1877504
1932

Number (Series of 1925) 620292 Dated Sep 13 1932
Div. 38 (Ex'r's Book) . . . .
Name John J. Grebe and Ross T. Sanford, Assors to The Dow Chemical Company of Midland, Mich, a corp of Michigan.
Invention Treatment of Deep Wells

ORIGINAL

Application Filed Complete June 30, 1932
Petition, Specification, Oath, First Fee $25, June 30, 1932
Examined and passed for Issue August 17, 1932
C. F. Krafft, Exr. Div. 38
Notice of Allowance Aug. 17, 1932

By Commissioner.

Final Fee $30—Aug. 17, 1932
Attorney, Thomas Griswold, Jr., c/o The Dow Chemical Co—Midland, Mich.
No. of Claims Allowed 11. Print Claim 1 in O. G.
Class 166-21
Title as Allowed—Treatment of Deep Wells

THOMAS GRISWOLD, JR.
Patent Research Dept.
The Dow Chemical Company
Midland, Michigan

Midland, Michigan, June 24, 1932
Inventors J. J. Grebe and R. T. Sanford
Title Treatment of Deep Wells
Commissioner of Patents,
Washington, D. C.
Sir:—

In connection with the above entitled case, please apply the enclosed remittance in payment of Patent Office fees in the amounts and for the purpose below indicated:
Patent Design Trade-Mark Application Filing Fee Twenty-five Dollars ($25.00)

Respectfully,
Thomas Griswold, Jr.,
Attorney.

PETITION AND POWER OF ATTORNEY

To the Commissioner of Patents:— 620292

Your petitioners, John J. Grebe and Ross T. Sanford, citizens of the United States, and residents of Midland, County of Midland, State of Michigan, and whose Post Office address is Midland, Michigan, pray that Letters Patent may be granted to them as joint inventors for the Improvements in Treatment of Deep Wells set forth in the annexed specification; and they hereby appoint Mr. Thomas Griswold, Jr., of Midland, Michigan (care of The Dow Chemical Company) (registration No. 12803) their attorney in this application, with full power in the premises.

John J Grebe
Ross T. Sanford

SPECIFICATION

To All Whom It May Concern:—

Be It Known that we, John J. Grebe and Ross T. Sanford, citizens of the United States, and residents of Midland, County of Midland, State of Michigan, have jointly invented a new and useful Improvement in Treatment of Deep Wells of which the following is a specification:

The present invention relates to the treatment of deep wells, such as oil, gas, brine or water wells, to increase the output therefrom. It is more especially concerned with the treatment of wells in which the mineral-bearing stratum consists of a limestone or other calcareous formation, or is contiguous to such a formation.

An object of the invention is to counteract some preventable natural causes for the decline of yield of a well. A familiar example is the decline of production of an oil well. When it is first drilled into an oil-bearing stratum, the release of pressure upon the oil deposit may cause the well to flow naturally for a certain length of time. The flow will gradually recede from the initial high point to the point where natural

flow does not produce a sufficient yield, and thereafter pumping will be resorted to, until the continued decline in output renders further operation unprofitable. In many cases, however, the stoppage of oil output is caused, not by exhaustion of the oil supply, but by the building up of solid deposits *of wax or the like* in the channels and pores of the oil-bearing rock which obstruct and finally may cut off altogether the flow of oil to the well.

Various methods have been used for opening up or cleaning a clogged well hole, such as drilling, "shooting," with explosive or by chemical treatment. The first two methods mentioned have the disadvantage that the pump rod and tube must be removed prior to applying the treatment, in addition to which, in the case of using an explosive, there is danger of damaging the casing. The chemical methods heretofore proposed have either not been found effective to clear the hole or they have involved the use of corrosive substances which are injurious to the metal parts of the well structure.

As an illustration, a chemical method is described in United States Patent 556,669, according to which the flow of an oil well in a limestone formation is increased by treating with a quantity of an acid, such as hydrochloric acid. The acid has the effect of attacking and dissolving the rock, thereby enlarging the cavity at the bottom of the well, or the channels and pores in the rock through which oil flows to the well. In actual practice, however, this method has never been generally adopted, due to the fact that the acid attacks the metallic casing, pump tube, etc., about as actively as the rock, and causes serious damage thereto.

We have now found that the last-mentioned method may be adapted for use in increasing or restoring the flow of oil wells by suitable modification without material injury to the casing or other metallic parts of the well. The treatment can be carried out at less cost and with better results than any of the methods heretofore employed. The invention, then, consists of the improved method hereinafter fully described and particularly pointed out in the claims.

In carrying out our improved method we employ a mineral

acid, preferably hydrochloric acid, inasmuch as the latter upon reacting with the calcareous rock forms water-soluble salts which remain in solution and are removed from the well with the spent acid. To the acid we add a small amount of a substance capable of inhibiting attack of the acid upon metal surfaces *, e.g. of iron or steel, copper, etc.,* with which it comes in contact. As the inhibiting agent we prefer to use an arsenic compound soluble in the acid solution, examples of which are arsenic acid, H_3AsO_4, arsenic trioxide, As_2O_3, or a soluble arsenate or arsenite, such as the corresponding alkali metal salts. The amount of arsenic compound added may be varied, but we have found that from 1 to 5 per cent thereof, based upon the weight of the solution, will be satisfactory for the purpose. Other inhibitors which may be used are cyanides, organic nitrogen bases such as aniline, phenyl-hydrazine, pyridine, quinoline, acridine and derivatives thereof, organic sulphur compounds, such as mercaptans, as well as various by-products of industrial processes, such as sludge acid from oil refining and residues from acid sulphite paper manufacture, etc.

The strength of the aqueous hydrochloric acid solution, in general *best adapted to the purpose in hand*, may be between about 5 per cent and about 20 per cent, and preferably should be between 10 and 15 per cent *although other concentrations may be used, if desired*. With such strength of acid the corrosive action thereof upon metals, particularly iron or steel, can be largely or substantially inhibited by adding thereto a relatively small amount of an arsenic compound or other inhibiting agent. Consequently, the acid can be introduced into the well through the pump tube, so that the latter need not be withdrawn prior to the treatment. It is sufficient merely to pull the pump rod and valves, and to pour the acid solution into the well through the tube. Due to the presence of the inhibitor there will be no substantial attack upon the pump tube, or upon the well casing if the charge of acid rises high enough in the well to contact with the casing.

The acid solution is preferably added in amount calculated to fill the bore of the well to a depth not exceeding the thickness of the mineral-bearing stratum. In order to force

the charge of acid out of the pump tube into the bore of the well against the head of oil standing in the hole, it may be followed by a charge of oil, water or other liquid sufficient to overcome the head, or pressure may be applied by other suitable means, e.g. by air pressure or by means of a pump. When introduced into the bottom of the well, the acid attacks the rock structure and dissolves or disintegrates it, thereby enlarging the pores and channels in the rock, or opening up new channels. The action of the acid upon a limestone formation causes the evolution of a considerable volume of carbon dioxide gas. This gas may be allowed to escape up the casing, or the latter may be capped off, thereby creating a gas pressure within the well which assists in forcing the acid into the pores and crevices of the rock. After the action of the acid has practically ceased, the spent solution containing the dissolved salts may be pumped or bailed out. In many cases it may be desirable to repeat the treatment one or more times. By making successive additions of smaller amounts of acid solution, and pumping out the spent acid between charges, a greater cumulative effect may be produced than by the use of a single larger charge. It is not necessary, however, to add the acid solution through the pump tube, as any other convenient way may be employed. For instance, the pump tube may be withdrawn and a dump bailer used to lower a charge of acid into the base of the bore.

In the practical use of our method in the central Michigan oil field, where the oil is derived from a calcareous rock formation, we have successfully used hydrochloric acid solutions of 10 to 15 per cent strength to which was added a small amount e.g. 1 to 5 per cent, of an arsenic compound. For example, to 4500 pounds of a 15 per cent hydrochloric acid solution was added 2 gallons of arsenic acid solution containing 21 pounds of arsenic calculated as As_2O_5. The mixed solution was charged into an oil well through the iron pump tube, being followed by a quantity of crude oil to force the acid solution out of the tube into the well. After the acid was exhausted, it was pumped out, and thereupon regular pumping of the oil was resumed. The production of the well was approximately doubled with one treatment.

The method has been used repeatedly for the treatment of low yield or exhausted oil wells in producing territory with a resultant increase of output amounting to as much as 75 to 200 per cent, and in some cases wells which have ceased to flow have been brought back with a resumption of natural flow. The treatment has been applied in the manner described without appreciable damage to the pump tube or well casing. The invention may also be employed similarly to increase the flow of gas wells and brine or water wells in cases where the mineral or water bearing stratum, or the immediately adjacent strata, are of a limestone or calcareous formation, or of a nature such as to be acted upon and dissolved by hydrochloric acid solution.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the method herein disclosed, provided the step or steps stated by any of the following claims or the equivalent of such stated step or steps be employed.

We therefore particularly point out and distinctly claim as our invention:—

—1—

In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well an aqueous hydrochloric acid solution to which has been
an agent capable of inhibiting action of the acid upon metals.
added a relatively small amount of ~~a corrosion inhibiting agent.~~

—2—

In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well an aqueous hyrochloric acid solution to which has been
capable of inhibiting action of the acid upon metals
added a relatively small amount of an arsenic compound.

—3—

In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or

brine, the step which consists in introducing into the well a 5 to 20 per cent hydrochloric acid solution to which has
capable of inhibiting action of the acid upon metals
been added from 1 to 5 per cent of an arsenic compound^.

—4—

In a method of increasing the output of a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well a 5 to 20 per cent hydrochloric acid solution to which has been added from 1 to 5 per cent of arsenic acid.

—5—

The method for increasing the output of an oil well
base
which comprises introducing into the ^ ~~bore~~ of such well a 5 to 20 per cent hydrochloric acid solution containing a relatively small amount of a corrosion inhibitor, permitting the acid to act upon the rock formation surrounding the well cavity and withdrawing the spent acid.

—6—

The method for increasing the output of an oil well
base
which comprises introducing into the ^ ~~bore~~ of such well a 5 to 20 per cent hydrochloric acid solution containing a rela
capable of inhibiting action of the acid upon metals
tively small amount of an arsenic compound^, permitting the acid to act upon the rock formation surrounding the well cavity and withdrawing the spent acid.

—7—

The method for increasing the output of an oil well
base
which comprises introducing into the ^ ~~bore~~ of such well a 5 to 20 per cent hydrochloric acid solution containing a relatively small amount of a corrosion inhibitor, permitting the acid to act upon the rock formation surrounding the well cavity while applying pressure upon the solution and withdrawing the spent acid.

—8—

The method for increasing the output of an oil well which comprises ~~pouring~~ *charging* into the pump tube a quantity of a 5 to 20 per cent hydrochloric acid solution containing a relatively small amount of a corrosion inhibitor, expelling the acid from the tube into the bore of the well by applying pressure thereon, permitting the acid to act upon the rock formation surrounding the well cavity and withdrawing the spent acid.

—9—

The method for increasing the output of an oil well which comprises ~~pouring~~ *charging* into the pump tube a quantity of a 5 to 20 per cent hydrochloric acid solution containing a relatively small amount of a corrosion inhibitor, expelling the acid from the tube into the bore of the well by applying pressure thereon, permitting the acid to act upon the rock formation surrounding the well cavity under pressure due to the gas generated thereby and withdrawing the spent acid.

Signed by us this 24 day of June, 1932.

John J. Grebe
Ross T. Sanford

OATH

State of Michigan, County of Midland, ss.

John J. Grebe and Ross T. Sanford, being duly sworn, depose and say that they are the applicants herein, citizens of the United States, and residents of Midland, Michigan; that they do verily believe themselves to be the original, first and joint inventors of the Improvement in Treatment of Deep Wells described and claimed in the foregoing specification, signed by them; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in this or any foreign

country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in this country for more than two years prior to this application; that their invention has not been patented to themselves or others with their knowledge or consent in any foreign country on an application filed by them, or their legal representatives or assigns, more than twelve months prior to this application and that no application for patent on same has been filed by them, or their legal representatives or assigns, in any foreign country, except as follows: —None.

John J. Grebe
Ross T. Sanford

Sworn to and subscribed before me, this 24 day of June, 1932.

(Seal) Geneva Turner,
Notary Public.

My commission expires July 7, 1934.

Midland, Michigan, July 30, 1932

Hon. Commissioner of Patents

Sir:

Prior to examination, I hereby amend as follows:

√Page 2, line 18, after "deposits" insert—of wax or the like—.

√Page 3, line 25, after "surfaces" insert—, e.g. of iron or steel, copper, etc.,—.

Page 4, line 10, after "general" insert—best adapted to the purpose in hand—; √line 11, change the period (.) to a comma (,) and add—although other concentrations may be used, if desired—.

√Claim 1, last line, cancel "a corrosion inhibiting agent" and substitute therefor—an agent capable of inhibiting action of the acid upon metals—.

√Claims 5-7, line 2 of each, change "bore" to—base—.

√Claims 8-9, line 2 of each, change "pouring" to—charging—.

Please add the following claims:—

10. In a method of treating a well for producing a

fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well an aqueous hydrochloric acid solution to which has been added a relatively small amount of an organic nitrogen base capable of inhibiting action of the acid upon metals.

11. In a method of treating a well for producing a fluid mineral product such as oil, gas, water or brine, the step which consists in introducing into the well an aqueous hydrochloric acid solution to which has been added a relatively small amount of an organic sulphur compound capable of inhibiting action of the acid upon metals.

REMARKS

The foregoing amendment to the specification is for the purpose of correcting and clarifying the text in certain details. The new claims added are of similar scope to claim 2, but read to two additional species. Claim 1 is to be regarded as the generic claim and claims 2, 10, and 11 read to three selected species, in accordance with Rule 41.

Respectfully

Thomas Griswold, Jr.,

ECB:GT Attorney.

PETITION TO MAKE SPECIAL

Hon. Commissioner of Patents

Sir:

Your Petitioner, The Dow Chemical Company, assignee of the entire right, title and interest in and to the patent application of John J. Grebe and Ross T. Sanford, Serial No. 620,292, filed June 30, 1932, for "Treatment of Deep Wells," by its attorney, for the reasons enumerated below and set forth in the accompanying affidavits, prays that the aforesaid application, Serial No. 620,292, be made special in order to expedite its early issuance into a patent.

The Dow Chemical Company is actively engaged in the manufacture and sale of specially prepared acid for treating oil wells in accordance with the method described in the

aforesaid application, and is also contracting with oil well operators for treating wells. The feature of the method consists in the use of a prepared acid which does not attack and corrode metallic pipes, valves, pumps, and other parts of well equipment. The first test of the method was made March 11, 1932. The success of the first and subsequent trial treatments of wells has led to the general adoption of the method for treating oil wells in the Central Michigan field, and such use is being extended to other fields. The rapid adoption of the method has attracted general attention in the oil producing industry, and competitors have entered the field who are making unauthorized and unlicensed use of the invention which is causing loss to Petitioner's business. It is submitted that a continuation of such infringement will cause unlimited and irreparable damage.

Wherefore your Petitioner begs that a favorable consideration be given to this petition, and that the application of John J. Grebe and Ross T. Sanford, Serial No. 620,292, be advanced for special action.

The Dow Chemical Company
By Thomas Griswold, Jr.,
Attorney.

AFFIDAVIT IN SUPPORT OF PETITION TO MAKE SPECIAL

State of Michigan, County of Midland, ss.

Your affiant, Russell L. Curtis, being duly sworn, deposes and says that he is Assistant Sales Manager of The Dow Chemical Company, assignee of the above identified application, and that he is familiar with the said application.

Affiant further avers that The Dow Chemical Company is actively engaged in the manufacture and sale of specially prepared hydrochloric acid for treating oil wells in accordance with the method described in the aforesaid application, including the contracting with oil well operators for

treating their wells. Although this business has been developed within the past six months, it already amounts to a considerable volume. Since June 1, 1932, approximately 55,000 gallons of prepared acid have been sold, sufficient at average rate of application for the treatment of over one hundred wells, and that twenty-eight wells have been treated on contract by The Dow Chemical Company.

Affiant further avers that the new method of treating oil wells has attracted widespread attention in the industry, that unlicensed use of the invention claimed in the aforesaid application is being made by competitors, and that such unlicensed use is being made openly in defiance with the rights of The Dow Chemical Company as assignee of the aforesaid application, particularly by the firm of Dougherty and McMillan of Mt. Pleasant, Michigan.

Affiant further avers that the business of treating oil wells and the like according to the invention has developed with great rapidity, that the knowledge of the method has spread throughout the industry, and that within the next few months the continuation of unlicensed use of the invention will seriously affect the sales of the acid product and of the service of The Dow Chemical Company and that irreparable damage will be done to its business unless reasonable patent protection can be granted promptly rather than having to wait upon the usual long delay in the Patent Office resulting from the arrearage in the examining division having charge of this application.

Russell L. Curtis.

Sworn to and subscribed before me this 1 day of August, 1932.

Fred H. Brown,

(Seal) Notary Public.

My Commission expires Apr. 19, 1933.

AFFIDAVIT IN SUPPORT OF PETITION TO MAKE SPECIAL

State of Michigan, County of Midland, ss.

I, Thomas Griswold, Jr., the undersigned, being duly sworn, depose and say that I am Patent Attorney for The Dow Chemical Company and am in charge of the Patent Department of said Company; that I am fully authorized and do hereby promise to follow closely the prosecution of the above identified application, Serial No. 620,292, and to cooperate in every way with the Examiner to expedite the issuance of the patent.

Thomas Griswold, Jr.

Sworn to and subscribed before me this 1st day of August, 1932.

Geneva Turner,
(Seal) Notary Public.
My commission expires July 7, 1934.

ASSOCIATE POWER OF ATTORNEY

Hon. Commissioner of Patents
Washington, D. C.
Sir:

You are hereby authorized and requested to recognize Messrs. Fay, Oberlin and Fay, a firm composed of Jesse B. Fay, John F. Oberlin and Horace B. Fay, 909 Leader Building, Cleveland, Ohio, (registration No. 3987), as my associate attorney in the above entitled application.

Respectfully
Thomas Griswold, Jr.,
August 1, 1932 Attorney of Record.

AFFIDAVIT

Your affiant, Almon S. Nelson, a registered patent attorney associated with Fay, Oberlin & Fay, states that he is familiar with the application of J. J. Grebe and R. T.

Sanford noted above and that he thoroughly understands the invention described and claimed therein:

Affiant avers that he has made a complete and comprehensive investigation through the appropriate classes of patents in the United States Patent Office involving treatment of wells and that as a result of such search, believes the invention set forth in said application to be a novel improvement over the prior art.

Affiant states that he has failed to find any patent or patents, disclosing the features of this application, i.e. the steps of the process recited in the claims.

Affiant further avers that he has carefully considered the claims in this application in view of the disclosures in the prior art and that he believes such claims to be patentable.

Almon S. Nelson.

Sworn to and subscribed before me, this 3rd day of August, 1932.

Anna A. Hammond,
(Seal) Notary Public, D. C.
Commission will expire 7/14/33.

AFFIDAVIT IN SUPPORT OF PETITION TO MAKE SPECIAL

State of Michigan, County of Midland, ss.

Your affiant, Thomas Griswold, Jr., being duly sworn, deposes and says that he is Patent Attorney for The Dow Chemical Company, assignee of the above identified application, that he is in charge of the prosecution of said application and that he is familiar with the specification and claims thereof. Affiant affirms that a salesman of The Dow Chemical Company has described to him the method of treating oil wells which has been employed by the firm of Dougherty and McMillan of Mt. Pleasant, Michigan, and that such method has been employed to treat at least four wells. Affiant further affirms that he has made a rigid com-

parison of the method practiced by the aforementioned firm and that it infringes at least some of the claims of the application, particularly claim 1 thereof. Affiant further affirms that he believes claim 1 and other claims in the application to be truly patentable.

Thomas Griswold, Jr.

Sworn to and subscribed before me this 3 day of August, 1932.

(Seal)

Geneva Turner,
Notary Public.

My commission expires July 7, 1934.

PETITION TO MAKE CASE "SPECIAL"

The petition to make this case special has been considered.

If the examiner can make this case special without prejudice to any possible interfering applications, and he should make a rigid search for such, he is authorized to do so for the first action. Should the application be rejected, the case will not be considered special for the subsequent action unless the applicant *promptly* makes a *bona fide* effort to place the case in condition for allowance even if it is necessary to have an interview with the examiner to accomplish this purpose.

If the examiner finds any interfering application for the same subject matter, he should consider such application simultaneously with this case and should state in the official letter of such application that he is taking it out of its turn because of a possible interference.

The petition is granted.

Thomas E. Robertson,
Commissioner.

Defendant's Exhibit 312

cfk) kh/d (Mailed Aug 8 1932)

DEPARTMENT OF COMMERCE
United States Patent Office
Washington

Please find below a communication from the Examiner in charge of this application.

Thomas Griswold, Jr;
c/o The Dow Chemical Company
Midland, Michigan

References made of record:

Muehl	1,410,827	Mar. 28, 1922	166/21
Lake et al.	1,498,045	June 17, 1924	"
Tilton	1,608,869	Nov. 30, 1926	"
Ranney et al.	1,806,499	May 19, 1931	"
Coggeshall	1,822,271	Sept. 8, 1931	"
De Groote	1,823,439	Sept. 15, 1931	"
" "	1,823,440	" 15, 1931	"

Bulletin 233 of the U. S. Bureau of Mines, (1925), pp. 82-85.

Petroleum Development and Technology in 1926. (book) published by American Institute of Mining and Met. Eng., Inc., p. 479, lines 9-11.

Claims 1, 5, 7, 8, and 9 are rejected on Ranney et al who carries out all steps of the process except that he makes no mention of using inhibitors. However, the use of chromates and mud-fluids as inhibitors is suggested in the book on Petroleum Development and Technology, and also in Bulletin 233 of the Bureau of Mines. The use of mud as an inhibitor is also suggested by Lake et al. Furthermore any dissolved chloride would operate as an inhibitor by suppressing the dissociation of the hydrochloric acid, and such chlorides would inevitably be present.

In view of the foregoing considerations it is not thought possible to draw any allowable claim which is not limited to some specific kind of inhibitor, and in the absence of any allowable generic claim, an election will have

to be made between the use of arsenic, nitrogen, and sulphur compounds as inhibitors. Division is therefore required between claims 2, 3, 4, and 6, claim 10, and claim 11.

C. F. Krafft,
Examiner.

(Application Div. Aug 13-32
U. S. Patent Office)

(U. S. Patent Office
Aug 13 1932 Division 38)

Washington, D. C., August 12, 1932.

Hon. Commissioner of Patents,
Sir:

In re application of Grebe et al., "Treatment of Deep Wells, filed June 30, 1932, Serial No. 620,292.

Attention is respectfully called to an interview had of the even date herewith, at which time the Primary Examiner agreed to reconsider applicant's claims in the light of the following argument which agreement is understood to waive the requirement for division at present.

The rejection of claims 1, 5, 7, 8, and 9 on Ranney et al is not understood. Ranney introduces a mixture of hydrochloric acid or nitric acid with a compound capable of reacting therewith to produce both heat and a gas (e.g. calcium carbide or other metal carbide) into an oil well. The well is then plugged and the gas formed by reaction of the carbide with the acid forces the latter into the oil-bearing rock structure. Ranney does not employ any agent capable of inhibiting the action of the acid upon metal surfaces within the well. To the contrary, he points out on page 1, lines 34 and 35 of his application that before treating the well according to his method "Any tubing or other equipment in the well casing is removed - - -."

The present invention comprises increasing the output of a well by introducing thereto a mixture of aqueous hydrochloric acid and a relatively small amount of an agent capable of inhibiting action of the acid upon metal equipment which may be present in the well. It is old, as is pointed out on page 3, lines 1-11 of the present application,

to treat an oil well with hydrochloric acid alone so as to increase the output thereof, but this method has never been generally adopted due to the fact that the acid attacks the metal casing of the well, pump tube, etc., and causes serious damage thereto. The impracticality of employing a strong mineral acid alone for oil well treatment is particularly pointed out on page 73 of the United States Bureau of Mines Bulletin No. 348, wherein it is stated

> "The use of strong acids such as hydrochloric and sulphuric as solvents for paraffin in oil wells is not recommended because paraffin is a relatively stable compound and will not be affected by such compounds. Furthermore, *acid may attack and do considerable damage to the equipment in the well - - -.*"

The utility of hydrochloric acid treatment in increasing the flow of an oil well was first pointed out by Frasch in United States Patent 556,669 in 1896, but this method has never found general application due to the danger of corroding metal apparatus within the well. Present applicants have found and are first to find that any of a wide variety of inhibiting agents may be added to hydrochloric acid to prevent its attack upon metal surfaces within a well and that the so-treated acid may be employed to increase the flow of a well without danger of corroding metal surfaces within the same. Since hydrochloric acid which contains a corrosion inhibiting agent does not attack iron, the acid, as pointed out on page 4, lines 15-17 of the specification,

> "can be introduced into the well through the pump tube so that the latter need not be withdrawn prior to the treatment."

Applicants' method, which is now being used extensively in certain oil fields, is advantageous over that described by Ranney in that applicants treat a well with aqueous hydrochloric acid which contains an agent capable of inhibiting the action of the acid upon metals within the well. Claims 1, 5, 7, 8, and 9, which were rejected on Ranney, distinguish from the latter in specifying that the

hydrochloric acid with which a well is treated shall contain such inhibiting agent.

In the last Office action it is stated

> "The use of chromates and mud-fluids as inhibitors is suggested in the book on 'Petroleum Development and Technology' and also in Bulletin No. 233 of the Bureau of Mines."

This statement is thought to be incorrect. In lines 9-13 of page 497 of "Petroleum Development and Technology" it is stated

> "In fact we find that both the depth of pitting and the total amount of corrosion *may be limited by the use of sufficient chromate. If an insufficient amount is used* to inhibit corrosion the *result would probably be* a slowing down of average rate of corrosion by an *acceleration of local corrosion in the form of pitting.*"

From the photostatic copy which is available of the above reference it is not clear what type of corrosion is referred to or to what purpose the corrosion inhibitor is to be applied. However, the reference shows clearly that a chromate cannot be applied successfully to prevent corrosion within a well, as it is perfectly evident that during pumping of the well the amount of chromate present would be reduced, but that a small amount of chromate would undoubtedly remain within the well and such small amount of chromate would increase the pitting of iron by corrosive agents. The above reference does not refer to the use of mud as a corrosion inhibitor.

Bulletin 233 of the United States Bureau of Mines gives a full discussion both of the use of chromates in preventing corrosion of iron apparatus within a well and of the use of mud for similar purpose. *The chromate treatment* is described on pages 84 and 85 of said reference and *consists in emmersing the iron or steel in solutions of inhibitive agents such as solutions of chromic acid and of certain chromate and bichromate salts.* Obviously, *such*

treatment of iron apparatus *must be carried out before the apparatus is placed within a well, hence the inhibiting agent*, a chromate, *is not employed along with an acid which is to be introduced* into the well. Furthermore, the reference specifically points out that such chromate treatment, when applied to iron apparatus which is to be used within a well, is useless as such corrosion inhibitor does not afford protection against chlorides or sulphates which may be present within the well, viz.:

> "*The protection afforded underground equipment by chromate solutions is of doubtful value* not only because the passive surface of the metals becomes scratched and worn away but *mainly because the passivity* is temporary at best and *is destroyed by chlorides* and sulphates *if present even in very small proportions in underground waters. A few hundredths of 1 per cent of a chloride* or a somewhat greater proportion of sulphate *appears to destroy the passivity afforded by chromate solutions. Chromate solutions may have special uses as inhibitors of the corrosion of surface equipment in the oil and gas fields, but for underground use in wells these reagents are believed to be useless.*"

The above quotation shows clearly that a chromate will not prevent corrosion of iron or steel by a chloride and this fact is particularly true if hydrochloric acid, which is known to be highly corrosive to iron and steel, is the chloride referred to. *A chromate, then, can not be used in small proportion along with hydrochloric acid to prevent said acid from attacking iron equipment within a well, hence a chromate cannot be used as an inhibiting agent in the manner described in the present application.* The reference does not describe treating a well with hydrochloric acid containing a corrosion inhibitor ~~nor~~ does it show there to be any advantage in treating a well with such mixture. The reference, then, does not anticipate the present invention.

Pages 73-82 of Bulletin 233 of the Bureau of Mines, describe the use of mud-fluids, oil muds, and cements to pre-

vent corrosion of well casings by corrosive fluids such as the brines which may be present in the various strata through which said casing may pass. The general method of applying such protective agents is outlined in detail on page 74 of the reference and consists essentially in forming a layer of the protective mud around the iron or steel casing of the well and between such casing and the various earth strata through which the casing passes. From the entire description of such mud treatment in the above article it is entirely clear that *the mud-layer does not play the part of a corrosion inhibitor*, but *rather it serves as a wall between the iron or steel casing of the well and corrosive liquids, such as brines, which may be present within the earth's surface. The reference does not disclose treating an oil well with a mixture of hydrochloric acid and mud, nor does it show that mud will inhibit the action of hydrochloric acid upon iron equipment within the well.* The reference, then, discloses no essential feature of the present invention and cannot be held to anticipate the latter.

Lake et al describe removing colloidal muds, clays, etc., from the walls of a well hole or from apparatus within said hole by introducing into the well that amount of a strong mineral acid which is required to destroy the colloidal properties of the muds, clays, etc. On page 1, lines 100 to 109 of his patent Lake states

> "*It is found that the acid or acids* used for these purposes *will not appreciably attack the metallic structures in the well hole*, such as tubing and casing, collars, and the like, where mud is present in the hole, *unless used to excess*, inasmuch as *when an approximate balance between the amount of acid and colloidal mud is maintained the acid action will be expended upon the mud rather than in attacking the metal.*"

Lake does not disclose the use of mud as an agent capable of inhibiting the action of excess acid on iron equipment within a well. To the contrary, he specifically has pointed out in the above quotation *that the protective action of the*

mud is due to it reacting with the acid more quickly than will iron or steel and he also has particularly pointed out that the acid must be employed in amount which shall not exceed that with which the mud will react, i.e. there must be a balance between the mud and the acid. Present applicants have shown that a relatively small amount of any of a wide variety of inhibiting agents may be added to hydrochloric acid and that thereafter said acid may be introduced into a well to increase the flow thereof without injury to any metal apparatus which may be within the well. In employing an inhibiting agent for such purpose, the acid is in great excess over the quantity of inhibiting agent present. In so far as is known, there is no chemical action between the corrosion inhibitor and the acid, and the acid is present in free form so that all of its activity may be expended upon the oil containing calcareous rock structure rather than upon iron apparatus present within the well. Lake does not show that mud may be introduced into an excess of hydrochloric acid and that the so-treated acid may be introduced into an oil well without injury to metal apparatus which may be within said well, and it is not thought that mud can be employed for such purpose. Lake does not disclose any inhibiting agent capable of preventing the action of *excess hydrochloric acid* upon the metal apparatus which may be present within a well treated with said acid, nor does he disclose adding any inhibiting agent to hydrochloric acid and subsequently treating a well with the acid. Lake, then, discloses no essential feature of the present invention and does not anticipate the same.

Muehl describes a method of cleaning oil wells which consists essentially, first, in dissolving solid or gummy paraffin hydrocarbons within the well with oil capable of dissolving the same, removing the resulting solution, then introducing acid into the well by means of a combination of a scraper and an acid container having zinc plates as a temporary bottom of the same, said container being filled with a strong mineral acid, such as hydrochloric acid. The well is scraped at the bottom thereof and at the same time

the acid gradually eats through the zinc plates and is introduced directly into contact with the oil bearing rock structure at the bottom of the rock. Muehl does not disclose the use of any agent capable of inhibiting the action of the acid upon metal apparatus which may be present within the well and the Examiner's attention is particularly directed to the fact that the acid employed by Muehl must be highly corrosive towards metals because the operation of Muehl's entire process is dependent upon the acid eating its way through the metal bottom of the container within which it is introduced into a well. Muehl does not disclose the essential feature of the present invention, hence cannot be held to have anticipated the latter.

Tilton describes a different method of cleaning an oil well. The principal steps of his method consist, first, in introducing water into the bottom of the well, next, lowering a container filled with sulphuric acid into the well and liberating said acid into direct contact within the water which was first introduced, thereby generating sufficient heat to melt a considerable portion of the solid paraffins which are present, next adding sufficient sodium hydroxide to completely neutralize the acid solution and at the same time generate sufficient heat to melt an additional quantity of the solidified paraffins which may be present and finally withdrawing the entire reaction mixture from the well. On page 2, lines 59 to 63 of his patent, Tilton states

> "If desired, potassium dichromate may be added to the acid. The function of the dichromate is to dissolve the final film of greasy material adhering to mineral matter in the well."

Tilton does not disclose the use of an agent capable of inhibiting the action of acid upon metal apparatus which may be present within a well. The dichromate which he mentions is employed as a corrosive agent toward paraffin matter and it has previously been shown by the quotation from the Bulletin No. 233 of the U. S. Bureau of Mines that a chromate or dichromate is not capable of inhibiting the

corrosive action of acid upon metals which may be present inside of an oil well. Tilton then does not anticipate applicant's invention.

Coggeshall treats an oil well with a solution capable of displacing oil from sand grain structures in the strata at the bottom of the well. As a colloidal solution suitable for such purpose he prefers to employ an alkaline aqueous solution containing a hydrocarbon sulfonic acid. He does not show such sulfonic acid to be an agent capable of inhibiting corrosion of iron. To the contrary it is well known that sulfonic acids as a class are comparable in strength with strong mineral acids and it would be expected that such acids would be corrosive to iron, not corrosion inhibiting agents. That sulfonic acids actually are corrosive to iron is clearly shown on page 2, lines 38 to 45 of the De Groote patent No. 1823439, wherein it is stated

> "As is obvious, the reagent can be employed as an acid mass, that is, as the *sulfonic acid*. However, this is not desirable, due to the corrosive action of such acidic material. Therefore, it is desirable that the acidic material . . . be neutralized with a suitable alkali."

Coggeshall then has not disclosed the treatment of a deep well with a mixture consisting of a strong mineral acid and an agent capable of inhibiting the action of said acid upon metals and therefore does not anticipate the present invention.

De Groote in each of his cited patents No. 1823439 and No. 1823440 respectively, describes a method of cleaning oil bearing strata of the earth by forcing solutions through the same from one well to another, said solutions being capable of removing oil surfaces which tend to adhere to sand grains. In the first of the above patents, he employs an aqueous solution containing a salt of an alkylated aromatic sulfonic acid for such purpose. It has previously been mentioned in the discussion of the Coggeshall patent, that De Groote points out on page 2, lines 33 to 45 of his patent No. 1823439 that such sulfonic acids should be neu-

tralized with an alkali before being used as the free sulfonic acids are highly corrosive. DeGroote does not mention the use of an acid solution containing an agent capable of inhibiting the action of the acid upon metals as a cleaning agent for wells, hence, does not anticipate the invention. The second of the De Groote patents i.e. patent No. 1823440, employs an aqueous solution containing "wood sulfite liquor" for cleaning oil bearing strata of the earth in a manner similar to that described above. On page 2, lines 5 to 10 of said patent it is stated

> "We prefer to neutralize it (wood sulfite liquor) prior to use in our process, so that the oil recovered by the process will not have a destructive corrosive action on the pipe lines, tank cars, or storage tanks in which said oil is subsequently confined."

De Groote then shows clearly that the wood sulfite liquor which he employs is corrosive to iron hence is not comparable with the inhibiting agents disclosed in the present application.

In the last Office action, it is stated

> "Furthermore, any dissolved chloride would operate as an inhibitor by suppressing the dissociation of the hydrochloric acid, and such chlorides would inevitably be present."

The accompanying affidavit of one of the inventors, John J. Grebe, is submitted to show that sodium chloride has no practical value as an agent for inhibiting the action of hydrochloric acid on iron. From the data presented in said affidavit, it may be seen that between 36 and 56 times as much iron was corroded in the presence of a 15% hydrochloric acid solution *saturated* with sodium chloride as was corroded in the presence of 15% hydrochloric acid solution containing a relatively small quantity of one of the inhibiting agents disclosed in the present application.

Hydrochloric acid is one of the strongest of all known mineral acids and sodium chloride cannot be dissolved in aqueous hydrochloric acid in amount sufficient to suppress

the ionization of the acid to such extent as to prevent it from reacting with iron or steel. The relatively small amount of brine, which may be present in an oil well, would have no appreciable action in suppressing the ionization of a hydrochloric acid solution. *Neither sodium chloride nor other metal chloride may be employed successfully to inhibit the action of hydrochloric acid upon iron or steel and if they could be so employed they would*, at the same time, *inhibit the action of said acid upon the calcareous rock with which it is intended that it shall react.* Metallic chlorides, then, cannot be employed in place of the inhibitors disclosed in the application, hence the fact that such chlorides are sometimes present within a well does not invalidate patentability of any claim in the application.

In the conference courteously accorded counsel for applicants on August 12, 1932, the Examiner suggested that authoritative opinions, decisions and patents showing the allowability of claims similar to claim 1 of the present application be pointed out in the response to the last Office action. The Examiner's attention is accordingly directed to the following authoritative opinions and patents:

1. Patent Claim Drafting—Stringham—Page 65. Inventions involving chemical principles may be defined according to the principles that determine the utility if the inventor has ascertained these principles. - - - The rule that an invention may be defined by its principle seems particularly applicable in chemical, quasi-chemical and composition cases.

2. Ibid—Page 116.

A composition may be defined by its properties or its ingredients.

3. Ex parte Sperr, 12 U. S. Pat. Q. 194. Claim including "catalyst effective in causing the conversion of said impurities after absorption," etc., held not too indefinite where applicant named several examples in specification since it leaves others free to search for other processes based on different principles than use of catalyst.

4. Patent Office Practice by McCrady—Page 82. "In

Ex Parte Hamilton, 85 O. G. 1742, 1898 C. D. 273," the Commissioner said:—

> "Applicant can not be permitted to use in his claims terms which are indefinite and general in their meaning without such qualifying words as shall make clear what is intended to be covered by them and shall be expressive of the purpose, location or function of the elements intended. - - - The specification is the dictionary which is to be used in interpreting the claims and if the terms of the claim are clear after reading the specification that is all that is necessary."

5. The following patents were issued during the year 1932. Each of said patents contains claims which specify a substance by its properties rather than by its name:— 1,843,376; 1,843,783; 1,850,997; 1,851,151; 1,851,362; 1,851,-363; 1,851,411; 1,851,565; 1,851,607; 1,851,754; and 1,851,-844. Of the above patents, Patent No. 1,851,565 is particularly pertinent and contains a claim having the following terminology:—

> "The method of recovering oil from underground strata in a well which includes projecting a stream of *liquid capable of breaking down the surface tension between the oil and the inert materials to free the oil from* the inert material, etc."

In view of the above authoritative opinions and issued patents, it is thought that the wording of the generic claims of the present application is in accordance with that usually considered proper by the Patent Office.

It has previously been pointed out that each of the rejected claims 1, 5, 7, 8, and 9 distinguishes from the references in specifying that the hydrochloric acid used for increasing the flow of a well shall contain an agent capable of inhibiting the action of said acid upon metals. Each of said claims is thought to describe the invention correctly and to be in proper form for allowance.

Claim 1 is generic to all claims in each of the divisions required in the last Office action, hence it is thought that the requirement of division should be lifted.

Each claim in the application is thought to describe an invention which is patentably distinct from the cited references and all claims are thought to be in proper form for allowance.

Respectfully,
Thomas Griswold, Jr.,
Attorney.
by H. A. Stearns

AFFIDAVIT

State of Michigan, County of Midland, ss.

I, John J. Grebe, the undersigned, being duly sworn, depose and say that I am by profession a physicist, having been graduated from the Case School of Applied Science in 1924 with the degree of B.Sc. in physics, and from the same school in 1928 with the degree M.Sc. in physics; that I am co-inventor with Ross T. Sanford for the above application for "Treatment of Deep Wells"; that the following experiments have been made in order to compare the utility of various corrosion inhibitors, disclosed in the above application, as agents to prevent attack of aqueous hydrochloric acid upon iron with the utility of sodium chloride for similar purpose:

Several iron plates of similar composition, size, and form were weighed, then the plates were separately immersed in the following respective solutions: a 15 per cent hydrochloric acid solution containing 10 cubic centimeters of ethyl mercaptan per liter of solution, a 15 per cent hydrochloric acid solution containing 10 cubic centimeters of n-butyl mercaptan per liter, a 15 per cent hydrochloric acid solution containing 10 cubic centimeters of n-heptyl mercaptan per liter, a 15 per cent hydrochloric acid solution containing 5 cubic centimeters of arsenic acid per liter, and a 15 per cent hydrochloric acid solution saturated with sodium chloride. Each test plate was permitted to remain

immersed in its respective acid solution for a measured and weighed. From the difference in weight of each plate before and after the acid treatment it was calculated that the rate of corrosion of iron, expressed as pounds of iron lost per square foot of iron surface per 24 hours, in the various solutions was the following:

15 per cent aqueous HCl containing	Pounds of iron lost through corrosion per square foot of surface per 24 hours
Ethyl mercaptan	.0332
n-Butyl mercaptan	.0321
n-Heptyl mercaptan	.0210
Arsenic acid	.0210
Sodium chloride	0.190

John J. Grebe

Sworn to and subscribed before me this 11th day of August, 1932.

Geneva Turner

My commission expires July 7, 1934.

DEPARTMENT OF COMMERCE
United States Patent Office
Washington

kra kh/d (Mailed Aug 15 1932)

Please find below a communication from the EXAMINER in charge of this application.

Thos. Griswold, Jr.;
c/o The Dow Chemical Co.;
Midland, Mich.

Responsive to letter of August 13, 1932.

Additional references made of record:

Laverty	856,644	June 11, 1907	148/8
Vogel	1,433,579	Oct. 31, 1922	"
"	1,460,395	July 3, 1923	"
Gravell	1,678,776	July 31, 1928	"
Chamberlain	1,719,167	July 2, 1929	"
Fischer	1,736,282	Nov. 19, 1929	"
Vignos	1,750,651	Mar. 18, 1930	"
Bertleff	1,757,829	May 6, 1930	"

Claims 1, 5, 7, 8, and 9 are rejected on Ranney et al in view of De Groote 1,823,439 which describes the use of sulphonates instead of sulphuric acid, the organic radical in the latter case acting as an inhibitor. That it will act in this manner is clearly explained in the above cited patents to Laverty, Vogel 1,433,579, Fischer, and Bertleff. Whether De Groote knew about this inhibiting action or not is immaterial. The use of an acid mixture is clearly described by De Groote in lines 38 and 39 of page 2 of his specification. The use of the alkaline substances described further on in his specification is only an additional safeguard against corrosion.

Claims 2, 3, 4, and 6 are rejected on either Ranney et al or De Groote in view of Gravell cited describing the use of arsenic to inhibit corrosion.

Claim 10 is rejected on either Ranney et al or De Groote in view of Vogel 1,460,395 or Chamberlain cited describing the use of nitrogenous organic bases to inhibit corrosion.

Claim 11 is rejected on either Ranney et al or De Groote in view of Vignos describing the use of an organic sulphur compound to inhibit corrosion.

C. F. Krafft,
Examiner.

Paper No. 7
(Mailed Aug 16 1932)

DEPARTMENT OF COMMERCE
United States Patent Office
Washington

Please find below a communication from the Examiner in charge of this application.

Thomas E. Robertson,
Commissioner of Patents.

Thos. Griswold, Jr.;
c/o The Dow Chemical Co.;
Midland, Michigan

In view of counsel's argument at the oral interview to the effect that applicant uses hydrochloric acid and not

sulphuric or sulphonic acid as in the references, it is thought upon reconsideration that the claims can be allowed. This application will therefore be passed to issue forthwith.

C. F. Krafft,
Examiner.

DEPARTMENT OF COMMERCE
United States Patent Office
Washington
August seventeenth, 1932

John J. Grebe, et al:

Your Application for a patent for an Improvement in Treatment of deep wells filed 6/30/32 has been examined and Allowed with 11 claims.

The final fee, Thirty Dollars, With $1 Additional For Each Claim Allowed in Excess of 20, must be paid not later than Six Months from the date of this present notice of allowance. If the final fee be not paid within that period, the patent will be withheld, but the application may be renewed within one year after the date of the original notice with a renewal fee of $30 and $1 additional for each claim in excess of 20.

The office delivers patents upon the day of their date, on which date their term begins to run. The preparation of the patent for final signing and sealing will require about four weeks, and such work will not be begun until after payment of the necessary final fee.

When the final fee is paid, there should also be sent, Distinctly And Plainly Written, the name of the Inventor, Title of the Invention, And Serial Number as Above Given, Date of Allowance (which is the date of this circular), Date of Filing, and, if assigned, the Names of the Assignees.

If it is desired to have the patent issue to an Assignee or Assignees, an assignment containing a Request to that effect, together with the Fee for recording the same, must be filed in this office on or before the date of payment of the final fee.

After issue of the patent, uncertified copies of the drawings and specifications may be purchased at the price of Ten Cents Each. The money should accompany the order. Postage stamps will not be received.

The final fee will Not be received from other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

Notice.—When the Number of Claims Allowed Is in Excess of 20, No Sum Less Than $30 Plus $1 Additional For Each Claim in Excess of Twenty Can Be Accepted as the Final Fee.

Respectfully,
Thomas E. Robertson,
Commissioner of Patents.

Thomas Griswold, Jr.;
c/o The Dow Chemical Co.;
Midland, Michigan.

Aug 17-32 575251A—Check 30.00
Rec'd U. S. Patent Office

FINAL FEE PAID TO THE COMMISSIONER OF PATENTS

(Be careful to give correct Serial No.)

Serial No. 620,292
Inventors: John J. Grebe et al.
Patent to be issued to The Dow Chemical Co.
Name of Invention, as Allowed: Treatment of Deep Wells.
Date of Payment: August 17, 1932
Fee: $30.—
Date of Filing: June 30, 1932
Date of Circular of Allowance: August 17, 1932

The Commissioner of Patents will please apply the accompanying fee as indicated above.

Thomas Griswold, Jr.,
Attorney.

DEPARTMENT OF COMMERCE
United States Patent Office
Washington

Aug. 25, 1932

Petition under Rule 78:

This petition is referred to Examiner in charge of Division 38 in accordance with Order No. 2698; Order No. 2801, 308 O. G., 447, and Notice of August 11, 1922.

Thomas E. Robertson,
Commissioner.

Washington, D. C., August 16, 1932.

Hon. Commissioner of Patents,
Sir:—

In re application J. J. Grebe, et al., "Treament of Deep Wells," Serial No. 620,292, filed June 30, 1932, the following changes are requested under the provisions of Rule 78.

AMENDMENT UNDER RULE 78

Claims 2 and 3, last line of each, and claim 6, line 4, after "compound" insert—*capable of inhibiting action of the acid upon metals*—.

REMARKS

During the course of an interview courteously accorded counsel for applicants on August 16, 1932, the Primary Examiner agreed that all claims in this application would be considered allowable, and that the above changes would be accepted under the provisions of Rule 78.

Respectfully,
Thomas Griswold, Jr.
by H. A. Stearns

Pat. 1877504

DEPARTMENT OF COMMERCE
United States Patent Office
Washington

Thos. Griswold, Jr;
c/o The Dow Chemical Co.;
Midland, Mich.

The amendment proposed has been entered under Rule 78.

Thomas E. Robertson,
Commissioner of Patents.

(Mail Room Jan 24 1934 U. S. Patent Office) #10

UNITED STATES DISTRICT COURT
District of Eastern Oklahoma

Honorable Commissioner of Patents,
Washhington, D. C.

Sir:

In compliance with the Act of February 18, 1922 (41 Stat. L. ...), you are advised that there was filed on the 18th day of January, 1934, in this court an action, suit, or proceeding No. 4523-Equity, entitled:

Name The Dow Chemical Company, a corporation, Plaintiff,
Address Midland, Midland County, Michigan,

versus

Name The Chemical Process Company, a corporation, Defendant.
Address Breckenridge, Texas. (Domesticated in State of Oklahoma, with place of business at Seminole, Seminole County, Okla.)

brought upon the following patents:

Patent No.	Date of Patent	Patentee
1,877,504	Sept. 13, 1932	The Dow Chemical Company, assignee

In witness whereof I have affixed my hand this 22nd day of January, 1934; at Muskogee, Oklahoma.

W. V. McClure, Clerk of said Court.

(Seal) By Larry Grimm, Chief Deputy.

(Mail Room May 7 1934 U. S. Patent Office) #11

DISTRICT COURT OF THE UNITED STATES
Northern District of Oklahoma

Honorable Commissioner of Patents,
Washington, D. C.

Sir:

In compliance with the Act of February 18, 1922 (42 Stat. L. 392), you are advised that there was filed on the 4th day of May, 1934, in this court an action, suit, or proceeding No. 968 Eq., entitled:

Name The Dow Chemical Company, a corporation, Plaintiff,
Address Midland, Midland County, Michigan

versus

Name Williams Brothers Well Treating Corporation, a corp., Defendant.
Address Tulsa, Tulsa County, Oklahoma,
brought upon the following patents:

Patent No.	Date of Patent	Patentee
1,877,504	Sept. 13, 1932	John J. Grebe and Ross T. Sanford.

In witness whereof I have affixed my hand this 4th day of May, 1934, at Tulsa.

H. P. Warfield, Clerk of said Court,
By M. M. Ewing, Deputy.

(Mail Division Jun 1-35 U. S. Patent Office) 12

UNITED STATES CIRCUIT COURT OF APPEALS
Tenth Circuit

Honorable Commissioner of Patents,
Washington, D. C.

Sir:

In compliance with the Act of February 18, 1922 (42 Stat. L. 392), you are advised that there was filed on the 28th day of May, 1935, in this court an action, suit, or proceeding No. 1285, entitled:

Name The Dow Chemical Company, Appellant,
Address Midland, Michigan,

versus

Name Williams Brothers Well Treating Corporation,
Address Tulsa, Oklahoma, Appellee,
brought upon the following patents:

Patent No.	Date of Patent	Patentee
1,877,504	Sept. 13, 1932	John J. Grebe and Ross T. Sanford.

In Witness Whereof I have affixed my hand this 29th day of May, 1935, at Denver, Colorado.

Albert Trego,
Clerk of said Court.

(Mail Division Jan 16 36 U. S. Patent Office) #13

UNITED STATES CIRCUIT COURT OF APPEALS
Tenth Circuit

Honorable Commissioner of Patents,
Washington, D. C.

Sir:

In compliance with the Act of February 18, 1922 (42 Stat. L. 392), you are advised that there was filed on the 28th day of May, 1935, in this court an action, suit, or proceeding No. 1285, entitled:

Name The Dow Chemical Company, Appellant,
Address Midland, Michigan,

versus

Name Williams Brothers Well Treating Corporation,
Address Tulsa, Oklahoma,
brought upon the following patents:

Patent No.	Date of Patent	Patentee
1,877,504	Sept. 13, 1932	John J. Grebe and Ross T. Sanford.

In the above-entitled case the following decision has been rendered or decree issued: Decree of the District Court reversed on January 10, 1936.

In Witness Whereof I have affixed by hand this 13th day of January, 1936, at Denver, Colorado.

Albert Trego, Clerk of said Court.
By H. A. McIntyre, Deputy Clerk.

DEFENDANT'S EXHIBIT 314

Disclosure No. 1173

Date, June 1, 1932 Case No. 850G

THE DOW CHEMICAL COMPANY

INVENTION CONCEPTION DATA SHEET

"When an invention is conceived—put it in writing, sign, date and have witnessed."

A. Name of Inventor(s)—J. J. Grebe.

B. Title of Invention—Mining Soluble Minerals with Acid.

M. Description of Invention—A charge of acid is placed in the bore in contact with an acid-soluble formation, such as limestone, dolomite, magnesite, or a like basic mineral, and permitted to react until CO_2 is no longer formed. The acid is then pumped out and pumpage of oil or other fluid mineral is continued when it is found that the output thereof has increased. Specifically, employ hydrochloric acid to which has been added enough arsenic to prevent substantial attack upon the iron tubing when the procedure may be as follows:—

The rods may be withdrawn from the pump-tube and the acid run down the tube, enough being used to fill the hole to cover the formation to be attacked. If desired, more acid may be added or the tube and casing may be sealed off to cause the gas pressure developed to force the acid into the stratum being attacked.

It is preferable to shoot the well with a small charge before treating with acid in order to extend the action of the acid into fissures in the rock, thereby opening up the flow lines.

Although it has been known for a long time that hydrochloric acid containing arsenic would not attack iron to any great extent, yet the use of an acid to open up a well, specifically an acid containing arsenic, is believed to be new. The strength of the acid should be adjusted to a gravity such that the resulting solution will dissolve the salts formed.

Inventor(s) John J. Grebe, July 2, 1932.

STIPULATION RE CONTENTS OF APPEAL RECORD

It is hereby stipulated by and between counsel for the parties hereto that the printed record herein, consisting of three volumes of testimony and proceedings and one volume of exhibits, pages 1 to 2048, inclusive, may be accepted as the complete record of testimony, proceedings and exhibits in the District Court in this cause, for the purposes of appeal, and that all exhibits printed in whole or in part in this record and all other exhibits which were given exhibit numbers in this case by the clerk of the District Court were duly offered and received in evidence.

It is further stipulated that the following exhibits shall be sent up as physical exhibits to the clerk of the Sixth Circuit Court of Appeals for use at the hearing and in the disposition of this appeal:

DX-11	DX-91	PX-247, 248
DX-11½	DX-92	DX-277–279
PX-15	DX-95-98	DX-280–286
DX-16	DX-100	DX-290-293, 295
PX-17	DX-106	DX-296, 297-299
PX-18	DX-107	PX-306-308
PX-22	DX-116–131	PX-310
PX-24, 25	DX-133–137	PX-317, 317A
PX-28–30	PX 168	PX-318, 318A
PX-32, 33	PX-184–186	PX-319, 319A
PX-35, 36	PX-190	PX-327
PX-69	DX-191	DX-332
PX-70	PX-193–215	PX-338-341
DX-75-82	DX-216	PX-343-346
DX-84	PX-217	PX-352
DX-85	DX-221–227	PX-355, 356
DX-87	PX-228–230	PX-359
DX-89	PX-244	PX-361
		PX-365

October 27, 1942.

Wilber Owen,
Counsel for Plaintiff.

Earl Babcock,
Counsel for Defendant.

CERTIFICATE OF CLERK

United States of America,
Eastern District of Michigan, Northern Division, ss.

I, George M. Read, clerk of the United States District Court within and for said district, do hereby certify that the foregoing printed pages numbered 1 to 2048, inclusive, contain a true and complete copy of the record and proceedings in this cause, including a copy of the judgment appealed from, a copy of the notice of appeal with its filing date, and a concise statement of the points to be relied on by the appellant, in accordance with the stipulation of the parties, dated October 27, 1942, on file in this office.

In testimony whereof I have hereunto signed my name and affixed the seal of said court at Bay City, in said district, this 31st day of October, 1942, and in the One Hundred Sixty-Seventh year of the Independence of the United States of America.

George M. Read, Clerk,

(Seal) By Clarence S. Pettit, Deputy Clerk.

PROCEEDINGS IN THE
UNITED STATES CIRCUIT COURT OF APPEALS
FOR THE SIXTH CIRCUIT

CAUSE ARGUED AND SUBMITTED

(October 11, 1943—Before Allen, Hamilton and Martin, JJ.)

This cause is argued by Wilbur Owen for Appellant and by Leonard S. Lyon and Earl Babcock for Appellee and is submitted to the court.

DECREE

(Entered December 17, 1943)

Appeal from the District Court of the United States for the Eastern District of Michigan.

This cause came on to be heard on the transcript of the record from the District Court of the United States for the Eastern District of Michigan, and was argued by counsel.

On Consideration Whereof, it is now here ordered, adjudged and decreed by this Court that the decree of the said District Court in this cause be and the same is hereby affirmed.

OPINION

(Filed December 17, 1943)

Before Allen, Hamilton and Martin, Circuit Judges.

Allen, Circuit Judge. This appeal attacks a decree finding invalid for want of invention Grebe & Sanford patent 1,877,504, of which appellant is assignee. The patent covers a method and process of "treatment of deep wells." By stipulation of the parties two other patents relating to the same subject, Grebe, 1,916,122, and Grebe & Stoesser, 1,998,756, were sustained, and the court found that the appellee infringed certain of the claims of each of them. The complaint was dismissed as to Chamberlain patent 2,024,718, but appellant has not questioned this action here. A counterclaim filed under Gravell patent, 1,678,775, was dismissed, the patent being held invalid, and no appeal was taken by appellee.

The Grebe & Sanford patent is especially concerned with the treatment of deep oil wells in which the mineral-bearing stratum consists of limestone or other calcareous formation, such as dolomite. The specifications state that the object of the invention is to increase the output from deep wells and to counteract some preventable natural causes for the decline of yield of a well, such as arise from the lack of sufficient ground pressure to cause the well to flow or from the building up of deposits of wax and other foreign substances in the channels of the oil-bearing rock which obstruct and may even cut off the flow of oil to the well. Among other methods for opening up a clogged well-hole the specifications particularly discuss that disclosed in Frasch patent, 556,669, for increasing the flow of an oil well in a limestone formation by treating it with acid, such as hydrochloric acid. The Grebe & Sanford specifications declare that "The acid has the effect of attacking and dissolving the rock, thereby enlarging the cavity at the bottom of the well, or the channels and pores in the rock through which oil flows to the well," but state that in actual practice this method has never been generally adopted, due to the fact that the acid attacks and damages the metallic casing and the pump tubes.

The claim is then made that the patent presents an improved method of using the hydrochloric acid treatment, which consists of adding to the acid a small amount of a substance capable of inhibiting attack of the acid on metal surfaces with which it comes in contact. For the inhibiting agent the use of an arsenic compound of from one to five per cent, based on the weight of the solution, is recommended. Numerous other inhibitors are also suggested. The recommended strength of the aqueous hydrochloric acid solution is between about five per cent and about twenty per cent, preferably between ten and fifteen per cent.

Claims 1, 5, 7, 8, and 9 are in suit. Claim 8 is typical and reads as follows:

> "8. The method for increasing the output of an oil well which comprises charging into the pump tube a quantity of a 5 to 20 per cent hydrochloric acid solution containing a relatively small amount of a corrosion inhibitor, expelling the acid from the tube into the bore of the well by applying pressure thereon, permitting the acid to act upon the rock formation surrounding the well cavity and withdrawing the spent acid."

The District Court found that the appellant in 1932 was the first to treat the producing formation of a limestone well with inhibited hydrochloric acid charged into the well through the pump tube, and that the appellee inhibits the hydrochloric acid used in its business of treating wells by the presence in the acid of dissolved lead and copper. However, the District Court dismissed the bill upon the ground that in adding a corrosion inhibitor to hydrochloric acid for use in acidizing wells, Grebe & Sanford were merely making use of the well-known qualities of such corrosion inhibitors without obtaining any new or unexpected result, and without creating any new process of acidizing a limestone formation. The court found that the addition of the corrosion inhibitor, in view of the prior art, required no more than

the ordinary skill of the calling and involved no patentable invention.

The appellee's acid in its initial state has no inhibitor added to it. It is transported to the wells in steel containers on the inside of which a number of lead sheets are brazed. A battery action is thereby set up and minute quantities of copper, lead and iron chlorides are deposited on the inside of the steel container, forming a protective coating. An acid solution of about fifteen per cent concentration is used by the appellee, and when the acid is inserted in the tubing of the well, the copper, lead and iron chlorides therein act to reduce corrosion from forty to sixty per cent. Although no chemical action is present between the hydrochloric acid and the arsenic compounds which are used by appellant as inhibitors, as is the case in appellee's process, the District Court found, we think correctly, that appellee infringes if the patent is valid. There is no substantial difference between the results secured by the appellee and that secured by appellant, and the method used is essentially the same.

The patent in suit was involved in a case heard in the Circuit Court of Appeals for the Tenth Circuit, *Dow Chemical Co.* v. *Williams Bros. Well Treating Corp.*, 81 Fed. (2d) 495. There the patent was held valid, and appellant relies largely upon that decision to support its contention that the decree must be reversed. The District Court found in the instant case that the method of acidizing disclosed in the Frasch patent, 556,669 (1896), was successfully used on a commercial basis in the acidizing of wells near Lima, Ohio, in 1895; that inhibited hydrochloric acid was used by the Gypsy Oil Company in 1928 to remove calcareous scale from pipe and equipment in certain wells, and that this use was reduced by the Gypsy Oil Company to successful commercial practice. The court found that many wells have been acidized successfully with commercial hydrochloric acid using no corrosion inhibitor both before and since the patent issued to Grebe & Sanford, and that during a great majority of the usual commercial acidizing operations the rate of corrosion of raw commercial hydrochloric acid upon steel

does not result in any material damage to the well pipe or equipment. All of these findings of fact are challenged by appellant on the ground that the Court of Appeals of the Tenth Circuit made diametrically opposite conclusions in the *Williams Bros.* case, *supra,* and that they are not supported by the evidence.

We think that each of these findings of fact is supported by substantial evidence. While the court in the *Williams Bros.* case decided that the Frasch method was cumbersome and impracticable, and that an alleged prior use by the Gypsy Oil Company in 1928 was no more than an unsuccessful and abandoned experiment, that court did not have the advantage of testimony presented in the instant case. We agree with the District Court that the evidence herein compels a different conclusion.

With reference to the use of the Frasch method, it clearly appears from the evidence, none of which was presented in the *Williams Bros.* case, that the Frasch method was used extensively in the oil fields of Lima, Ohio, in 1895 and 1896. The gist of Frasch's invention was the application of hydrochloric acid to limestone formations for the purpose of opening and broadening the channels in the rock through which the oil would run into the well. Frasch calls his invention "a method of increasing the flow of oil wells in limestone formations." He especially recommends the use of hydrochloric or muriatic acid to open the channels in the limestone because these acids dissolve the rock itself and the product of the chemical reaction does not remain to obstruct the passages.

Frasch recognized that hydrochloric acid would corrode the equipment. He not only suggested the use of a packer around the tubing, which was criticized in the *Williams Bros.* case, but also the use of enameled or lead-lined pipe to conduct the acid into the well, and the use of an alkaline liquid to neutralize the acid after it had performed its function, thus eliminating corrosion. None of the nine claims of Frasch mentions the packer or specifies any means of reducing corrosion. Frasch was concerned only incidentally with this problem. His essen-

tial conception was to attack the limestone rock with a chemical reagent which would disintegrate the rock, increase its porosity, and open the channels into the pay. In this he fully succeeded.

The use of Frasch's invention increased the production of oil wells in limestone formations by large percentages. The increase in production of one well in the Lima field, due to use of this method in 1895, was three hundred per cent, and was stated to be permanent, and a number of other wells in that field, after being treated with hydrochloric acid under this method, showed a remarkable increase. In June, 1932, the Oil Makers Company began to acidize wells in Michigan and treated many wells successfully with uninhibited hydrochloric acid. The superintendent of the McClanahan Oil & Gas Company testified that a number of these operations resulted in "a nice increase" of oil, most of them without damage to the equipment. The Oil Makers Company was compelled to suspend business, not as appellant urges, because of lack of success, but because of lack of capital, the falling price of oil, and letters written by appellant threatening to sue the company and its customers for "use of acid in any manner" which would infringe the patents. The Oil Makers Company construed this to mean that it would be sued if it used raw acid, that is acid containing no inhibitor.

The Chemical Process Company since 1932 has successfully acidized 15,000 wells, serving most of the major oil companies and using in almost all instances raw acid. Thus it has been employing the Frasch method.

The Gypsy Oil Company prior use of 1928 and 1929, found by the District Court to anticipate the patent in suit, although held in the *Williams Bros.* case to be an "unsuccessful and abandoned experiment," appears from the evidence here to have been a complete "scientific success." It involved the use of inhibited hydrochloric acid to clean scale from well equipment in sandstone formation. Appellant's endeavor to establish that this prior use is not material because it was employed in sandstone formation instead of in limestone has no weight, for con-

cededly appellant's invention, if there is invention, relates solely to the protection of the well equipment from corrosion by the acid, and not to the action of the acid upon the rock. This was the relevant part of the problem presented in the treatment of these wells in sandstone formation, and hence if the prior use is established it anticipates.

In 1928, the Mellon Institute was requested to advise the Gypsy Oil Company, a division of Gulf Oil Co., as to the proper solvent for dissolving the scale which formed inside the tubing of certain wells and impeded their operation. Dr. Blaine B. Wescott made a report on behalf of the Institute, suggesting the use of hydrochloric acid as solvent. Recognizing that some of the metal of the tubing, casing and sucker-rods would be lost in the acid, the report proposes the use of an inhibitor such as is employed in the steel mills, and suggests Rodine #2 for the purpose. The William Berryhill well No. 8 was treated by this method in 1928, with complete success, and similar successful treatments of other wells followed into 1931. The treatment of the Anderson well No. 3, stressed by appellant, involved an attempt not to remove scale, but to prevent its formation by a treatment not recommended in the report, and was not successful. While the Gypsy Oil Company discontinued these treatments, due to the very low price of oil at that time, the company felt that it was accomplishing the results desired, and the treatments can not be dismissed as an "experiment" or as being "abandoned." The practicability of the method recommended by the Institute was completely established and its utility demonstrated over a sufficient period to constitute a prior use. Cf. *Corona Cord Tire Co.* v. *Dovan Chemical Corp.*, 267 U. S. 358, 384. Moreover, the testimony of Dr. Wescott, which was not before the Tenth Circuit, shows that the use of inhibitors to protect metal from hydrochloric acid was well understood at that time so that in that respect no problem whatever was presented for solution. The use of the inhibitor in conjunction with the acid was suggested by the Institute as a matter of course.

The record is replete with testimony not presented in

the *Williams Bros.* case, to the effect that the use of an inhibitor is not necessary to the successful acidization of an oil well. One expert states that the inhibitor cost more than the damage to the equipment would have amounted to had raw acid been used. Since the adjudication of the *Williams Bros.* case in 1936, the Gypsy Oil Company has treated all of its wells with uninhibited acid and the record of the Chemical Process Company is cogent evidence in support of the finding of fact of the District Court upon this point.

Under the findings of fact, therefore, a very narrow question is presented upon the issue of validity. The Tenth Circuit considered that the question of patentability of Grebe & Sanford revolved around the problem of the increase in the flow of the well. It stated in effect that this process increased the ultimate recovery from the sand, and that the production of more oil in a more efficient way is accomplished by the patent in suit. It concluded that the acid without the inhibitor had proven to be a failure, and held that Grebe & Sanford "conceived the idea of dissolving the formation in which nature stored its oil." But the patent itself recognizes the fact that this idea was conceived by Frasch, and that increase in production was obtained by the Frasch method; and in the instant case appellant's expert stated that the inhibitors "would have no effect on the acid in connection with its reaction upon limestone," and that the result "would be limited apparently to the equipment, rather than to the well itself." Hence under appellant's own testimony the increase in the flow of the well is not the problem claimed to be solved, for since the addition of the corrosion inhibitor to the hydrochloric acid does not affect the action of the acid upon the limestone, no new process is created. The object of the invention, as stated by appellant's expert, is simply to protect the equipment from the hydrochloric acid. The single question is whether the conception of adding a corrosion inhibitor to hydrochloric acid for use in acidizing wells in order to reduce corrosion requires anything more than the ordinary skill of the calling or involves any patentable invention.

All the elements of the claimed combination were old. It was old to increase production by the use of hydrochloric acid under pressure. The use of this very process was suggested to Grebe & Sanford by the Pure Oil Company prior to the issuance of the patent in suit and was not original with them. It was old to use inhibitors with hydrochloric, phosphoric, and other pickling acids to reduce corrosion on iron and steel. Cf. Patent to Beneker, 914,916 (1909); Patent to Holmes, 1,470,225 (1923); Patent to Gravell, 1,678,775 (1925). The use of inhibitors other than those based on arsenic is shown in Fischer & Stegemeyer, 1,736,282 (1929); Rhodes, 1,746,677 (1930); Vignos, 1,750,651 (1930); Harrison, 1,766,902 (1930). Scientific publications, describing the use of inhibitors, are in evidence, dating from 1845. The only novel element here was that appellant first charged the inhibited hydrochloric acid into the limestone formation through the pump tube. The application of these two old principles to an oil well and the obvious step of conducting the acid through the pump tubing did not constitute invention, in view of the prior art as presented in this case. All that was required was expected mechanical skill. No new result was achieved. Cf. *Grinnell Washing Machine Co.* v. *Johnson Co.*, 247 U. S. 426, 433, 434.

While appellant attacks the specific findings of the District Court which hold that the method of increasing the flow in the oil well was old and widely known, it relies here, as it did in the *Williams Bros.* case, upon commercial success to establish invention. The extensive commercial success of appellant is at least partly referable to the phenomenal growth of the demand for oil during the last few decades, and to appellant's powerful business organization. But patent monopoly is granted not for commercial success, but for novelty and invention. Commercial success of itself does not create invention. Cf. *Paramount Publix Corp.* v. *American Tri-Ergon Corp.*, 294 U. S. 464. Commercial success is only a factor entering into the decision, when the question of invention is open to doubt. *Bulldog Electric Products Co.* v. *General Electric Co.*, 105 Fed. (2d) 466 (C. C. A. 4). Here the question is

not open to doubt, for even the alleged meritorious results appear not to have been demonstrated. When invention does not exist commercial success is immaterial. *Grosjean* v. *Panther-Panco Rubber Co.*, 113 Fed. (2d) 252 (C. C. A. 1); *Evr-Klean Seat Pad Co.* v. *Firestone Tire & Rubber Co.*, 118 Fed. (2d) 600 (C. C. A. 8); *Rid-Jid Products, Inc.*, v. *Rich Pump & Ladder Co.*, 103 Fed. (2d) 574 (C.C.A. 6).

The decree is affirmed.

PETITION FOR REHEARING

(Filed January 17, 1944)

IN THE

United States Circuit Court of Appeals

FOR THE SIXTH CIRCUIT

No. 9392

THE DOW CHEMICAL COMPANY, A CORPORATION,
Plaintiff-Appellant,

vs.

HALLIBURTON OIL WELL CEMENTING COMPANY,
A CORPORATION,
Defendant-Appellee.

PETITION FOR REHEARING

The Dow Chemical Company, appellant, respectfully petitions Your Honors to grant it a rehearing in this cause for the reasons hereinafter set forth.

It is respectfully urged that the opinion of this court in holding invalid the patent in suit, previously held valid by the Tenth Circuit Court of Appeals in the case of *The Dow Chemical Company vs. Williams Brothers Well Treating Corporation*, 81 Fed. (2d) 495, has misapprehended the effect of the new evidence in this record and has failed to apply long recognized principles of patent law. In view of the propriety in the instant case of a writ of *certiorari* by the Supreme Court to resolve the conflict between the decision of this court and that of the Tenth Circuit Court

of Appeals, it would seem proper that we point out the record facts which, in our judgment, require a reversal of the decree of the District Court herein.

Statement

The court recognized that appellant "was the first to treat the producing formation of a limestone well with inhibited acid charged into the well through the pump tube" (Opinion, p. 2), yet held that this did not require anything more than the ordinary skill of the calling or involve any patentable invention (p. 6). It based its departure from the ruling of the Tenth Circuit Court of Appeals primarily on the theory that evidence presented here and not before the court in the Tenth Circuit compelled a different conclusion on the question of validity.

We will first consider the character and effect of the new evidence and will then consider the court's conclusion that what Grebe-Sanford did required nothing more than the ordinary skill of the calling and did not involve invention.

The new evidence may conveniently be classified as follows:

1. That relating to the use of the process of Frasch patent 556,669 in approximately a dozen wells in the Lima, Ohio, oil field in 1895 and 1896.

2. That relating to the acidizing of oil wells with raw hydrochloric acid subsequent to the invention and public use of the process of the patent in suit.

3. That relating to the use of inhibited hydrochloric acid to remove deposits of gyp from the tubing in sandstone wells of the Gypsy Oil Company in the Glenpool in Oklahoma during the period 1928 to 1931.

On each of these points we respectfully submit that the court either has misconstrued the evidence or has drawn incorrect conclusions therefrom, as we shall now endeavor to point out.

I. The New Evidence Regarding Frasch

This evidence is that the process described in the Frasch patent was tried in approximately a dozen wells in the Lima, Ohio, limestone field during a period of less than two years beginning in October, 1895, and that substantial increases in production resulted from some of those treatments.

The statement of the court that Frasch "fully succeeded" in his conception of attacking the limestone rock with a chemical reagent so as to increase production is refuted by the history of the art, which shows that no practical use was ever made of Frasch's conception after 1896.

Insofar as any benefit to the public or the oil industry was concerned Frasch's patent may as well never have issued and the soundness of his conception that hydrochloric acid would attack oil bearing limestone formation, increase its porosity and open new channels may as well never have been demonstrated, for he failed to provide a practicable method of applying his discovery as evidenced by its complete abandonment after a few trials.

The very success of the early Frasch experiments in demonstrating that the production of oil from limestone formations could be increased, followed by non-use for thirty-five years, is in itself cogent proof of the practical failure of his process.

The fact that the correctness of Frasch's conception was demonstrated in a few wells adds nothing to the patent

disclosure as a reference against Grebe-Sanford. The patent states that the introduction of hydrochloric acid into oil producing limestone formation will eat away the limestone and increase the flow of the well. (R. 1936.)

The Tenth Circuit Court of Appeals and the Examiners in the Patent Office accepted these statements at their face value (as indeed they must have for they were also being urged by Grebe and Sanford) and reasoned from the disclosure of the Frasch patent that the Grebe and Sanford discovery involved that quality which characterizes it as invention rather than the expected skill of the art. The additional evidence here shows nothing more than that the Tenth Circuit Court reasoned correctly and it can form no proper basis for arriving at a different result.

When the Grebe-Sanford process was introduced and took the oil industry by storm, the Frasch process had been dead and forgotten over a third of a century. What stronger proof could there be that Frasch was a commercial failure, precisely as Judge McDermott reasoned it must have been in the absence of proof that it had gone into commercial use?

We respectfully submit that the distinction between commercial use and commercial success, as laid down by this court in *Motor Improvements vs. General Motors*, 49 Fed. (2d) 543, 545, is sound, and that an application of the principle there laid down would have resulted in a finding that the Frasch method as described in his patent and tried in the Lima field was a commercial failure.

Why Frasch failed may not be important, but it is significant that at the time he made his discovery and at all times since, the means by which Grebe and Sanford made his discovery commercially useful and valuable were readily available and did not depend on progress or new

discoveries in other arts. We respectfully submit that this court has erred in attributing any practical success to Frasch by reason of the short use of his process in the Lima oil field. The successful demonstration of a scientific fact by means of a process not commercially practicable should not be resorted to for the purpose of striking down a meritorious invention. The Frasch process for acidizing oil wells was no more complete or successful than would be the conception of an aeroplane which would fly but which could not land without damage to its equipment.

II. The New Evidence Regarding the Acidation of Wells With Raw Acid by Others Than Frasch

The record is absolutely silent as to any attempt to acidize an oil producing formation with hydrochloric acid between the date of Frasch's experiments in 1895-6 and the date of the Grebe-Sanford invention.

After the Grebe-Sanford process had been used quite extensively and with universal success in the Michigan oil fields in the spring and early summer of 1932, several men who had become familiar with that process undertook to acidize oil wells in the Michigan fields by the use of *raw* hydrochloric acid introduced directly through the pump tube. They called themselves the Oil Makers Company and acidized their first well on July 24, 1932, using only *raw* acid purchased from Pennsylvania Salt Manufacturing Company, of Wyandotte, Michigan. (R. 1259.) They so treated from 35 to 40 wells (R. 1225) and received complaints of damage to fully half of them. (R. 1203-12, 1259-69.) Because they received so many complaints they changed to the use of inhibited acid purchased from Grasselli Chemical Company of Cleveland. The first check to Grasselli for this acid was dated September 19, 1932, for

the sum of $475.00, and these purchases from Grasselli continued monthly thereafter until April of 1933 (R. 1199-1200), when they discontinued the business because of lack of capital and the falling price of oil. The president of the company testified (R. 1238):

> "* * * The reason that our company was unsuccessful and had to go out of business was that the price of oil went down in Texas and Louisiana. It was just impossible to make collections. No one wanted to treat their wells to increase production when they weren't getting enough money for their oil."

At the top of page 5 of the opinion the court erroneously assumes that this testimony refers to the discontinuance of the use of raw acid by the Oil Makers Company, whereas it actually refers to the discontinuance of the business of acidizing wells with *inhibited* hydrochloric acid purchased from the Grasselli Chemical Company and after it had been using that acid for more than six months. The undisputed testimony of those in control of the Oil Makers Company is that it discontinued the use of raw acid because of the extensive damage it was causing to well equipment.

Walter Sprenger, who had actual charge of the treatments with raw acid up to the time he quit the company about the middle of September, 1932, testified, after referring to a treatment made by him on September 12, 1932:

> "* * * That is the last well that I treated for this organization, and when I quit working for them I talked with my associates and told them that I was quitting. I told them that I believed that the business was too big for us. We were causing more damage than we were making money to pay for. I also told them that unless we found some way to use the acid without causing so much trouble to the steel material in the well, that it was useless to continue to use it. I talked to Mr. Charles Dougherty, Mr. Fred Markey and Edgar Lee."

Mr. Dougherty testified (R. 1226):

> "All the troubles came from using raw acid."

And Lee testified (R. 1171):

> "At the last we bought our acid from the Grasselli Chemical Company of Cleveland, Ohio. The Grasselli Company claimed that they had an inhibitor in their acid that would do away with the trouble that we had been having, and that was the reason we changed our source of supply for acid."

In spite of these proofs the opinion of the court clearly creates the inference that Oil Makers Company was successful in its business of treating wells with raw acid.

In further support of the finding that the treatment of wells with raw acid was commercially successful the court states that the Chemical Process Company "since 1932 has successfully acidized 15,000 wells, serving most of the major oil companies and using in almost all instances raw acid."

The only support for this finding is the uncorroborated testimony of an interested witness (Pitzer) whose company would be an infringer if he admitted that it used an inhibitor in its acid. That it used inhibited acid before the patent in suit was sustained in the *Williams* case is not denied, and the undisputed proofs show that rolls of lead plate have been found in a number of its truck tanks, the only possible purpose of which was to cause the formation of lead and copper chlorides in the acid, which are the identical inhibiting agents utilized by defendant in its present infringing process. Pitzer's denial of the use of inhibited acid is entitled to no more weight than was defendant's denial of infringement in this case. We proved that defendant's denial was not in accordance with the facts, and both the trial court and this court have held with us on the question of infringement. No proofs were offered

by defendant in support of Pitzer's statement that his company uses raw acid, and we had no opportunity to disprove that statement. No samples or analyses of Pitzer's acid were produced, yet the court accepted his uncorroborated statement in spite of the proof that his tanks contained rolls of sheet lead which inevitably would produce lead and copper chlorides in the acid.

The use of raw acid without any special protective equipment subsequent to the date of the Grebe-Sanford invention can have no direct bearing on the validity of the patent in suit. Furthermore, such use is not here in issue and is not charged to be an infringement of that patent.

Even if such subsequent use of raw acid was thought by the court to have an indirect bearing on the consideration of this case, the question for determination, we respectfully submit, is not whether in occasional instances or in some pools the acid passes through the tubing and into the formation so rapidly that no material damage results to the well equipment from the use of raw acid, but whether the *business* of acidizing wells with raw acid has ever been commercially successful. That it has not been commercially successful, whether the raw acid is introduced through a special tubing, as in Frasch, or through the regular well tubing, as attempted by the Oil Makers Company, is established by a strong array of undisputed facts:

1. Frasch tried it in 1895-6 and abandoned the effort after treating approximately a dozen wells.

2. Oil Makers Company tried it for two months in the late summer of 1932 and did so much damage to well equipment that it was obliged to change to the use of the more expensive inhibited acid in order to continue in business.

3. Defendant, Halliburton Company, used raw acid in the first two or three wells it acidized in the early months of 1935 and thereafter added an inhibitor to its acid until after the Grebe-Sanford patent was sustained by the Tenth Circuit Court of Appeals. Instead of then changing to the use of raw acid, it discontinued entirely its acidizing business for many months and until its experts devised the process which both the lower court and this court have held to infringe.

Against this array of undisputed evidence that it is not commercially practicable to carry on the business of acidizing oil wells with uninhibited acid, this court accepts the uncorroborated statement of a biased witness (Pitzer) that his company has successfully acidized 15,000 oil wells with uninhibited acid, and that in spite of undisputed testimony that Chemical Process Company places rolls of sheet lead in its acid tanks and that the inhibitors which defendant utilizes in its present infringing process (copper and lead chlorides) would inevitably result from the contact of the raw acid with such lead sheets.

III. The New Evidence Relating to the Gypsy Prior Use

This new evidence consists of a deposition of Dr. Wescott of the Mellon Institute, who recommended the treatment in question, and a second deposition of Dr. Knappen of the Gypsy Oil Company, whose deposition in the *Williams* case was stipulated into this record. Neither of these witnesses professes to have any first-hand information on the question here involved, *viz.*, whether the trial of the Wescott suggestion by Gypsy Oil Company constituted nothing more "than an unsuccessful and abandoned experiment," as found by the Tenth Circuit Court of Appeals, or was "completely established and its utility dem-

onstrated over a sufficient period to constitute a prior use," as found by this court.

Both these witnesses testified that they had not been present at any of the treatments on which appellee relies to establish this prior use, and both testified that their information came from the official reports and correspondence, which are present in the same form and to the same extent in both records. (R. 1082, 1087, 1102, 1111, 1113.)

It follows that there is no evidence in this record with respect to the actual treatments and the results thereof that was not present in the *Williams* record. This applies not only to the treatment to the William Berryhill Well No. 8 on November 18, 1928 (the only one of these treatments referred to in the official reports and correspondence), but it also applies to the treatments to Thomas Gilcrease Well No. 22 on September 4, 1929, and to William Berryhill Well No. 11 on September 11, 1929. Kiser is the only witness who claims to have been present at either of these later treatments, and his testimony is identically the same in both records, having been taken in the *Williams* case and stipulated into this record.

Moreover, Knappen's testimony must be considered to be the same in both records by virtue of his statement that if his testimony in this record differs from his testimony in the *Williams* record, the earlier evidence should be taken as true because the facts were then more freshly in his mind. Furthermore, Wescott's testimony adds absolutely nothing to this record, as he testified that he did not see any of these wells treated and gained all his knowledge of such treatments from the written records thereof, which are the same in this case as they were in the *Williams* case. (R. 1091, 1111.)

Accordingly, there is presented this situation: On identically the same record insofar as the actual treatments and the results thereof are concerned the court in the *Williams* case found that the Wescott method was nothing more than an unsuccessful and abandoned experiment, and this court found that it was used on the William Berryhill Well No. 8 "with complete success, and similar successful treatments of other wells followed into 1931."

On November 20, 1928, eight days after the treatment to William Berryhill Well No. 8, Dr. Knappen wrote to Dr. Foote of Mellon Institute (R. 1682):

> "The first *experiment* with the acid has been run at Glenpool with *unsatisfactory* results. * * * The acid apparently destroyed much gyp but the pump was choked with sand and it has been necessary to pull the pump several times in order to get the well to pumping normally. * * *" (R. 1683. Emphasis ours.)

The only evidence of additional treatments is the uncorroborated testimony of the witness Kiser, whose testimony is the same in both records. But even if Kiser's testimony be accepted at its full face value it does not support the above quoted statement in the opinion. The only two uses of the Wescott method to which he testified were in September, 1929. (Finding 67, R. 1488.) There is no proof of any other trial of this method, but there is undisputed proof of trials by Gypsy Oil Company of various other methods of removing gyp in the Glenpool during the period 1929 to 1932, clearly showing that they did not consider the Wescott method to be a solution of their gyp troubles.

On August 5, 1929, they treated William Berryhill No. 26 with a commercial gyp solvent. (R. 1687.)

In July, 1931, they tried the so-called trickling treatment in J. Anderson Well No. 3. (R. 1690.)

On April 12, 1932, they tried removing gyp from T. Gilcrease Well No. 21 by the use of a mechanical scraper, and two days later an engineering report recommended the use of such a scraper in J. Anderson Well No. 3. (R. 1693, 1695.)

And in May, 1932, they were looking for some kind of a gyp treating material "that would not be destroyed by reaction with the scale before reaching the bottom," as was the case when hydrochloric acid was used. (R. 1697-8.)

This record, we submit, falls far short of establishing "complete success" for the Wescott method, even if the treatments testified to by Kiser as having been made in September, 1929, be accepted as proven and as having been successful. But Kiser's uncorroborated testimony cannot be taken at its face value.

The latest statement by the Supreme Court on this subject was in *Smith vs. Hall*, 301 U. S. 216, 222:

> "This oral testimony, if taken at its face value, would show that the Smith method was used in the Brooklyn incubator with eggs in staged incubation. But without corroboration, it is insufficient to establish prior use. *The Barbed Wire Patent*, 143 U. S. 275, 284; *Deering vs. Winona Harvester Works*, 155 U. S. 286, 300; *Eibel Process Co. vs. Minnesota & Ontario Paper Co.*, 261 U. S. 45, 60. * * *"

Nor does the testimony of Dr. Wescott "that the use of inhibitors to protect metal from hydrochloric acid was well understood at the time" add anything to the record before the court in the Tenth Circuit. In a footnote on page 496 of the opinion in the *Williams* case the court refers to a number of patents which fully set forth the use of inhibitors in acid to protect metal from attack thereby, and the opinion, on the same page, states that the use of inhibited acid was "long known in the steel industry."

IV. The Conclusion That What Grebe and Sanford Accomplished Involved Nothing More Than the Ordinary Skill of the Calling and Did Not Involve Patentable Invention

We respectfully submit that this conclusion is contrary to the evidence and substitutes the intuition of the court as to what should have been obvious to those skilled in the art for the actual experience of those engaged in the production of oil and interested in increasing the output of their wells. The facts may be briefly summarized as follows:

1. In 1895-6 the oil industry learned through the issuance of the Frasch patent and the wide publicity given the Frasch experiments that hydrochloric acid introduced into the producing formation of limestone wells would dissolve the limestone, enlarge the pores or channels through which the oil flows to the well, and increase the production.

2. For more than a third of a century it had been common knowledge that the corrosive action of hydrochloric acid on iron and steel can be prevented or reduced by adding to the acid small amounts of substances known as inhibitors.

3. The number of limestone oil fields in this country had gradually increased to over 400 at the time the Grebe-Sanford invention was made.

4. There was a threatened shortage of oil during the greater part of the period between Frasch and Grebe-Sanford.

5. The prices of crude oil were high during the greater part of the period between Frasch and Grebe-Sanford.

6. The Grebe-Sanford invention was made during a period of low prices for oil, yet it went into immediate successful and extensive use.

7. Imitators and infringers sprang up almost immediately after the introduction of the Grebe-Sanford process, some of them (Oil Makers and Halliburton) at first attempting the use of raw acid and then changing to inhibited acid.

8. When the Grebe-Sanford patent was sustained, appellee discontinued its acidizing business entirely because it was no longer free to add an inhibitor to its acid, and did not resume its acidizing business until after its experts had devised its present infringing process.

9. The chemists, geologists, oil engineers and experts of Gypsy Oil Company, all interested in increasing the production of oil by their employer, learned through the Wescott report and the reports on the treatment of William Anderson Well No. 8 by the Wescott process in November, 1928, that inhibited hydrochloric acid could be safely used in the well tubing and that it would dissolve oil soaked gyp (calcareous deposits), yet it did not occur to any of them (all skilled in the art) to apply that information to the treatment of Gypsy Company's limestone wells with inhibited hydrochloric acid to increase their production.

10. Gypsy Company's failure to apply the Wescott process to the treatment of its limestone wells to increase production can be explained only on the theory that the Wescott process did not anticipate Grebe-Sanford (as found by the Tenth Circuit Court of Appeals, contrary to the conclusion reached by this court); nor can their failure to so apply Wescott be explained on the theory of lack of interest, low price of oil or high cost of acid, because the Gypsy Company was one of the first large oil companies to employ Dow's licensee, Dowell Incorporated, to acidize its limestone wells, at an expense of $250.00 or more per well.

CONCLUSION

We respectfully submit that the court erroneously concluded that the new evidence here requires or justifies a different conclusion from that reached by the Tenth Circuit Court of Appeals (1) as to the effect of Frasch on the validity of the patent in suit, (2) as to the commercial success of treating oil wells with raw hydrochloric acid, (3) as to the effect of the proofs in support of the alleged Gypsy prior use, (4) as to the effect of the Gypsy prior use (even if established) on the validity of the patent in suit, and, finally, (5) as to the validity of the Grebe-Sanford patent.

We respectfully urge that this petition be granted and that we be afforded an opportunity to reargue this case.

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I hereby certify that in my opinion this petition is well founded in fact and law, and that it is not interposed for purposes of delay.

Wilber Owen,
Of Counsel for Appellant.

ORDER DENYING PETITION FOR REHEARING

(Entered January 31, 1944)

The petition for rehearing is denied.

UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SIXTH CIRCUIT

I, J. W. Menzies, Clerk of the United States Circuit Court of Appeals for the Sixth Circuit, do hereby certify that the foregoing is a true and correct copy of Record and Proceedings in the case of *The Dow Chemical Company* v. *Halliburton Oil Well Cementing Company*, No. 9392, as the same remains upon the files and records of said United States Circuit Court of Appeals for the Sixth Circuit, and of the whole thereof.

In Testimony Whereof, I have hereunto subscribed my name and affixed the seal of said Court at the City of Cincinnati, Ohio, this 27th day of March, A. D. 1944.

J. W. Menzies,
Clerk of the United States Circuit Court of Appeals for the Sixth Circuit.

(seal)

SUPREME COURT OF THE UNITED STATES, OCTOBER TERM, 1944

No. 50

ORDER ALLOWING CERTIORARI—Filed May 15, 1944

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Sixth Circuit is granted.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.

SUPREME COURT OF THE UNITED STATES, OCTOBER TERM, 1944

No. 61

ORDER ALLOWING CERTIORARI—Filed May 15, 1944

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Sixth Circuit is granted.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.